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CERCIOEIRAS

UiT The Arctic University of Norway

ospedale riabilitativo

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Universitat Politècnica de València (UPV).
The research group participating in this project, UPV-SABIEN has an extensive expertise in the application of ICT to the social and healthcare systems. The group is also responsible for several health-related web sites, including several social webs, and it is very active in the health2.0 domain.

Instituto Valenciano de Servicios Sociales (IVASS)
IVASS is a public entity that spends more than 80% of its resources trying to improve the quality of life of more than 1.000 adults with intellectual disabilities aspiring to become active citizens. IVASS is aware of challenges in this context as well on the level of the person with an intellectual disability as on the level of the professional and social support system.

Cooperativa Educação e Reabilitação de Cidadãos com Incapacidade (CERCIOEIRAS)
Cercioeiras is a Cooperative Social Solidarity and Public Utility of Oeiras that aims to be an organization of excellence and a reference in constructing in inclusive society. Cercioeiras has been putting efforts in promoting exercise and motor activity since it´s foundation..

Ospedale Riabilitativo di Alta Specializzazione (ORAS)

ORAS is a highly specialized rehabilitation hospital providing ordinary and outpatient treatments for patients with temporary or permanent disabilities characterized by a high scale of complexity, high clinical and nursing needs.

University of Tromso (UiT)

The Health informatics and techonology (HIT) group at the Department of Computer Science, Faculty of Science and Technology, University of Tromso has a long tradition working with clinicians. The research approach is experimental (medical computer science) with a focus on implementing and testing of health care technology (artefacts). The research of the group focuses on mobile terminals and systems for personalized health, enhanced patient interaction through ICT, electronic disease and health surveillance, motivational mechanisms in eHealth and increased physical activity for people with intellectual disabilities through Ehealth tools.

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PREFACE

As a senior physician, researcher, and mother to a daughter with intellectual disability and autism, I consider the theme of this book to be of outmost importance, drawing from both my professional insights and personal experience. I am grateful for the opportunity to contribute to the preface of this book, especially after closely following the progress of MoveIT. While physical activity contributes to health and well-being, individuals with intellectual disability often experience barriers participating in such activities. A lack of knowledge exists in how to increase their participation in physical activity, necessitating innovative approaches.

Mobile health with the use of applications may offer innovative solutions to promote physical activity among people with intellectual disability. For people in the general population both applications and wearable devices such as fitness trackers are easily available. The situation is not the same for individuals with intellectual disability. The integration of technology into physical activity programs for individuals with intellectual disability opens up new possibilities. This was the background for an interdisciplinary group of researchers at the University of Tromsø (UiT) – The Arctic University of Norway to initiate a PhD project about promoting physical activity among individuals with intellectual disability through mobile health support. Led by Professor Gunnar Hartvigsen, applications specially developed to encourage physical activity in this group were developed by master's students at the Department of Computer Science at the UiT- The Arctic University of Norway. During a research visit to

Tromsø, Professor Antonio Martinez Millana found inspiration and later realized the international Move-IT project involving participants from Spain, Italy, Portugal, and Norway.

Physical activity plays a crucial role in enhancing the physical, mental, and social well-being of individuals with intellectual disabilities (ID). Engaging in regular physical activity can lead to numerous physical benefits, as well as enhancing psychological wellness while promoting social integration. Unfortunately, persons with ID live with a lot of different barriers, hampering them from being physically active enough. However, thanks to recent developments of technological tools, there are now new possibilities that can help them to face such barriers. In the present book we explored how exergaming, which combine physical exercise with gaming, can offer a unique and effective way to promote physical activity among individuals with ID. By engaging in exergames, individuals with ID can enjoy interactive and stimulating activities that require physical movement, thereby improving their motor skills, cardiovascular fitness, and overall physical health. Exergaming also provides opportunities for social interaction, cognitive stimulation, and psychological well-being. Another interesting aspect we explore in the book is the possibility to tailor the activities to individual needs and abilities, making it a versatile and inclusive tool for promoting physical activity and enhancing the quality of life for persons with ID.

The four chapters within this book explore the importance, and possible limitations, of physical activity in persons with ID and how to motivate increased activity through the exergaming,

providing a comprehensive understanding of the challenges, approaches, technologies, with a special focus on the Apps we developed in this project.

Chapter 1 sets the stage by defining intellectual disabilities and highlighting the barriers that often hinder individuals with ID from engaging in physical activity. It emphasizes the importance of tailored approaches to address the unique needs of this population.

Chapter 2 delves into the guidelines for motor activities, offering practical insights on how to design and implement effective physical activity routines for individuals with intellectual disabilities. It underscores the significance of personalized strategies to enhance engagement and participation.

Chapter 3 explores the role of recreational physical activities in promoting overall well-being and quality of life for individuals with ID. It sheds light on the numerous benefits of incorporating enjoyable and meaningful activities into their daily lives.

Chapter 4 highlights how ICT, including exergaming, can enhance physical activity engagement and offers innovative strategies for promoting exercise through different forms of technologies and possible solutions for persons with ID.

By incorporating tailored physical activity routines and utilizing innovative approaches such as exergames, it becomes possible to help in a new way persons with ID to lead healthier, more active lives and improve their overall quality of life. Through a blend of

research insights, practical recommendations, and real-world examples, this book aims to help and encourage readers to approach the ICT in individuals with ID in order to promote a positive impact on their lives.

Written for both professionals and family members, this book on physical activity is tailored to support individuals with intellectual disability. Offering insights, strategies, and practical guidance, it serves as a valuable resource. I extend warm wishes to the authors for their dedication and the readers for their engagement.

This preface was written by Audny Anke, professor and senior doctor at the University Hospital of North Norway (UNN) and University of Tromsø (UiT) – The Arctic University of Norway, together with professionals from ORAS.

INDEX

1. THE IMPORTANCE OF THE PHYSICAL ACTIVITY IN PERSON WITH INTELLECTUAL DISABILITY

1.1 Defining the Intellectual Disability

1.2 Physical activity and its relationship to physical and psycho-social health in pwID

1.3 Barriers to physical activity in pwID: policy programme, Social, Environmental, Individual

1.4 Why can exergames be helpful?

1.1 Defining the Intellectual Disability

Intellectual disability is a complex condition affecting individuals in their developmental skills in several domains of functioning including cognitive, motor, auditory, language, psychosocial, moral judgement and specific integrative adaptive activities of daily living. An estimated 3.5 million persons with intellectual disabilities (pwID) live in the Member States of the European Union, if it is assumed that most developed countries 3 report an overall prevalence rate of 1%. Because of such intrinsic complexity, the scientific community is still trying to elaborate a common framework in order to study, rate, classify and define ID and the way it affects the individual life of persons suffering from such conditions.

For this reason, different definitions and classification systems have been historically proposed for intellectual disability, and the complexity of such conditions still challenges across the world the field of epidemiology. According to the World Health Organization (WHO) we can define ID as "*a condition of arrested or incomplete development of the mind, which is especially characterized by impairment of skills manifested during the developmental period, skills which contribute to the overall level of intelligence, i.e. cognitive, language, motor, and social abilities*" (*http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/mental-health/news/news/2010/15/childrens-right-to-family-life/definition-intellectual-disability; 2012*). At the same time, the International Classification of Functioning, Disability and Health (ICF), further shape the concept by introducing the idea of body functions and participation level

according to the specific disabling condition *(https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health)*. According to ICF model, 'body-function and structures' refers to anatomical parts and physiological functioning of a person, resulting in the so called 'impairments' when damaged; 'activity' alludes to the execution of a task and the ease with which this is performed; issues with completing an activity are described as 'activity limitations'; the third component, 'participation', and possible restrictions when present, refers to the involvement in a given life situation. Interestingly, these three components are always mediated by the interaction between personal and environmental factors.

From the clinical point of view, the level of severity of ID has been traditionally rated according to the cognitive skills of the individual person. For example, the International Statistical Classification of Diseases and Related Health Problems (ICD-10) has adopted the notion of Intellective Quotient as a significant statistical factor for a proper diagnosis on the level of cognitive functioning. By keeping the focus on the clinical aspect of this condition, a recent important step was made by the new version of *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5). First of all, the expression of 'mental retardation', previously adopted in the earlier versions of the manual, has been replaced by 'Intellectual Developmental Disorder'. In particular, this expression is included in the text in order to stress the emergence during the developmental period of such difficulties. Another important advance we have assisted is the alignment between DSM and the terminology used by WHO's International

Classification of Diseases, allowing the professional from different disciplines to share the same vocabulary when referring to individuals with intellectual disability *(https://www.psychiatry.org/File%20Library/Psychiatrists/Practice/DSM/APA_DSM-5-Intellectual-Disability.pdf)*. Finally, DSM-5 emphasized the need to consider together the clinical and functional assessment with the use of standardized tests for intelligence evaluation, by taking into account the adaptive functioning rather than IQ test scores alone as a crucial factor to assess the severity of ID.

1.2 Physical activity and its relationship to physical and psycho-social health in pwID

Children and adults with ID are a very vulnerable class of persons, and they need long-life assistance to live a healthy life. For example, as far as regards the younger population, the countries members of the European Union have ratified the United Nations Convention of the Rights of the Child and most have signed the United Nations Convention on the Rights of Persons with Disabilities. However, at the same time, the health needs of these persons are still unfulfilled. Recently, this picture has been becoming even more actual and dramatic during the Covid-19 pandemics: in fact, the limitations imposed by the pandemics intensified the segregation of pwID during that period, isolating them in an unprecedented way with dramatic effects on their quality of life (QoL) and health-care assistance (*https://www.inclusion-europe.eu/europe-rights-equal-intellectual-disabilities/*). Above all, lockdowns hampered them to take the stimulation and rehabilitative assistance they needed, leaving them alone and their families without instruments for adequate assistance. Hence, in an unprecedented way, it has become even more urgent to promote the QoL of such a population and overcome possible affecting factors.

Among all different variables affecting the health and QoL, physical activity has been considered one of the most preeminent. As stated in the ICF model, the health status is influenced by the body function, the participation and the possibility to be engaged in various activities, that are also impacted on by environment and personal factors. Notably, these

concepts are connected with the definition and perception of QoL. According to the WHO, QoL is described as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.

Individual QoL is a multidimensional phenomenon that is composed of different domains that reflect one's personal well-being. QoL domains are influenced by personal and environmental factors and are enhanced by individualised support strategies. Indeed, the concepts usually investigated by questionnaires on the QoL are for example self-efficacy, life satisfaction, health status and social interaction. According to the literature, the so-called 'QoL Supports Model' has proven to be a useful instrument, providing a framework for the planning and delivery of a coordinated set of person-referenced support strategies that prevent or mitigate one's disability. From the macroscopic point of view, QoL principles stress the idea that QoL is characterized by different domains including both subjective and objective aspects, influenced by personal and environmental factors, which are not static but possibly subject to continuous changing process. Specifically, the authors found eight domains that define one's perception about QoL. They include personal development, self-determination, interpersonal relations, social inclusion, rights, emotional well-being, physical well-being and material well-being. Two domains are of particular interest for our discussion: self determination and physical well-being. The first element regards the possibility of making choices and exercising self-determination; these concepts can again be linked to the ICF element "participation", as stated in the

previous section, meaning the possibility of being engaged in activity but also to deciding for oneself. The second element, physical well being, refers to health status and activity in daily living, attributing an important role to being healthy and engaging in significant activity. In these terms it is recognized as a central function of physical activity and being active, as a tool to persecute and maintain good health.

Health and QoL disparities affecting pwID are a critical public health concern. A growing body of literature has indicated that, compared to the general population, individuals with ID experience disproportionate rates of secondary disease states, including but not limited to arthritis, asthma, cardiovascular disease, diabetes, periodontal disease, and gastrointestinal conditions. Obesity is a major contributor to poor health and is a highly prevalent risk factor for individuals with ID. A major contributor to obesity is a sedentary lifestyle, whereas physical activity is a health-sustaining behaviour that improves health outcomes for individuals with ID.

Physical activity provides many benefits for pwID, including improved cardiovascular health, better motor skills and strengthening bones and muscles. Regular physical activity can also help to manage weight, reduce the risk of chronic diseases, and improve overall quality of life.
In addition, physical activity benefits the mental health of pwID. Regular PA practice reduces stress, pain, and depression feelings, helps perceive daily living activities (ADLs) to be easier and enhances self-esteem.

Due to their social component, the practice of sports and physical exercise increases the social integration of pwID, reducing stigmatisation and negative stereotypes.
While bearing in mind such benefits, it is worth noting that not all physical activities are suitable for everyone, and a plan that is tailored to the individual's needs is necessary to achieve the most benefits.

According to the literature, physical activity offers numerous benefits for pwID, including:

- Improved cardiovascular health: Regular physical activity can help to reduce the risk of heart disease and stroke, which are common health concerns for pwID.
- Better motor skills: Physical activity can improve gross and fine motor skills, such as balance, coordination, and hand-eye coordination, which can benefit daily living activities.
- Increased social interactions: Physical activity can provide opportunities for individuals with intellectual disabilities to engage with others and develop social skills.
- Enhanced self-esteem: Participation in physical activity can lead to a sense of accomplishment and increased self-confidence, which can positively impact mental health.
- Weight management: Physical activity can help manage weight, which is essential as pwID are at higher risk of obesity.
- Decreased risk of obesity, improved cardiovascular fitness, and increased bone mineral density in this population.

- Reduced risk of chronic diseases: Physical activity can help to reduce the risk of developing chronic diseases such as diabetes and hypertension, which are more common among individuals with intellectual disabilities.
- Improved overall quality of life: Physical activity can enhance overall quality of life, including better mood, sleep, and cognitive function.
- Overall, physical activity can be a powerful tool for improving the health, well-being, and quality of life of pwID.

Notably, it is not uncommon that pwID might experience difficulties in being physically active. As reported in the 'QoL Supports Model', it is possible to identify a system of resources and strategies enabling persons to mitigate or overcome a possible disease condition, the so-called 'System of Supports Elements'. Among them, we can identify the 'Inclusive Environments' (sensitive to contextual variables, influencing the opportunity of inclusion and promoting autonomy) and 'Generic Support' (strategies, tools, persons, helping the individuals to promote their daily living), including the 'Technology' sector (see later for a discussion).

In particular, inclusive environments need to be sensitive to contextual variables that influence opportunities for inclusion; facilitate coordination among support providers and the respective education, employment, or residential environment; and make available both formal, paid supports (if necessary) and informal natural supports.

For these reasons, when it comes to identifying a person's support, we need to understand the current mismatch between one's personal competence and the environmental demands within which a person lives, works, learns, interacts, and recreates. Hence, the essential purpose of systems of support is to reduce the discrepancy between an individual's functional limitations and environmental demands and thereby enhancing their functioning and personal well-being. Inclusive environments might indeed provide access to community-based resources, information, and relationships, encouraging growth and development and accommodating psychological needs related to autonomy, competence, and relatedness.

Therefore, while the concept of QoL is multifaceted and dependent by a number of factors peculiar to the single individual, among them the role of physical activity related to QoL has been widely demonstrated in the literature. Indeed, physical activity has been demonstrated to be not only recommendable but also fundamental for pwID, being beneficial to promote the QoL (see above). In addition, it may also represent a fundamental incentive to enhance their level of social support and involvement. Among consequences, such impairments might discourage pwID to be active and involved in daily activities, with a twofold effect on health and psycho-social wellness.

1.3 Barriers to physical activity in pwID: policy programme, Social, Environmental, Individual

One leading factor associated with the decreasing level of being physically active is represented by the presence of the so-called barriers. Indeed, according to the literature the level of participation to physical activity can be understood by the interaction between five domains able to explain barriers (and relative facilitators): physical factors and health disorders (comorbidity); psychological, cognitive, and emotional factors; behavioural attributes/skills; social/cultural factors (values); and physical environment factors (e.g., weather conditions). Since commonly pwID exhibit lower level of physical participation than recommended, understanding barriers is fundamental to develop and implement external facilitators helping pwID to feel more involved and motivated to be active instead of sedentary.

Among personal barriers, psychological, cognitive and emotional states are usually considered as leading factors affecting personal involvement. In particular, motivation to be active has been commonly considered a key factor when referring to physical activity in pwID. It specifically refers to a leading psychological dimension able at evoking a particular action/movement and determining the strength and persistence of an individual's behaviour. In order to understand this dimension in pwID, different theoretical models have been considered and assumed in order to promote the level of physical participation. One of the most important models on motivation was proposed by Bandura (Bandura, 1978), who proposed the concept of self-

efficacy according to which persons would have specific beliefs about themselves and their capacities to do something: these ideas would represent the background of each single action and to regulate the levels of motivation. Importantly, self-efficacy ideas are not static, but they can change thanks to the experiences and social influences. The so called 'behavioural choice theory' (Epstein and Roemmich, 2001) posits that the choice to be active or sedentary strongly depends on the access (i.e., the amount of work or effort needed to engage in the behaviour) to sedentary and active alternatives and the reinforcing value of those alternatives. The authors thus hypothesise that when the reinforcement for active and sedentary activities appears to be equal, people would commonly experience the behaviour with the least, most accessible 'cost'. In general, we know that enjoyment of physical activity is positively associated with participation and adherence to the proposed activity. Another fruitful psychological model on motivation is represented by the so called Self-Determination Theory (Ryan and Deci, 2000): in particular, the authors suggested that motivation can be rated as not present, present thanks to intrinsic motivation (interesting, affordable by itself), present thanks to extrinsic, external motivation factors (e.g., specific rewards, positive feedback). Interestingly, previous research has demonstrated that extrinsic factors to promote motivation might play an important role for promoting physical activity in pwID. Importantly, the level of motivation strictly interacts with the social contexts surrounding pwID: for example, the attitudes, positive beliefs, healthy habits and enthusiasm demonstrated by persons very close to pwID have been demonstrated to play a crucial factor in terms of

perceived motivation to be active. Accordingly, literature suggests that factors such as positive experiences, accessibility, social support (i.e., family and/or friends) may facilitate the level of participation and to be physically active. Another important factor is represented by the way the physical activity is presented to the individual when it comes to ask him/her to be physically active, and if the activity itself takes place in an interacting dimension between the individual and the surrounding context (possibly with) other persons, as the level of motivation might increase when they experience the activity as fun, socially engaged and occurring in a supporting social context (it becomes clear the significant interaction between the individual and the context, the intrinsic and extrinsic factor). As far as regards social context and support, caregivers and peers are included. According to the literature focusing on multicomponent interventions, the presence of a caregiver is a positive factor that impacts on self-efficacy and also facilitates the engagement in physical activity. In case of some difficulty, the caregiver might help pwID to reduce the complexity of a multimodal activity (an intervention that includes more types of sub activities) and to develop a more positive perception of exercise. It is well known that peers can also have a positive effect on physical activity with a person with ID, particularly when they assume the role of mentors or motivating agent by supporting participants in taking decisions, making changes and building confidence in their ability to exercise.

Other types of barriers are represented by the external environment and its safety level. In detail, there are a number of specific factors possibly playing as barriers for pwID according

to the given living area, such as weather conditions, lack of transportation in the living zone, lack of safe and accessible streets as well as lack of awareness of possible alternatives. Moreover, policy programmes might not be able to intercept the needs and features of a given area to be as supportive as necessary, thus limiting the presence of needed resources, providing insufficient staffing, unavailability of healthcare assistance with an adequate level of preparation and community-based settings and program.

The need to understand how to overcome these barriers becomes crucial since recent literature has demonstrated that social and contextual enriched dimensions enabling motor activity are able to stimulate brain plasticity in ID individuals. Therefore, the development of strategies promoting physical activity and its positive effects still represents a challenging research and clinical domain. Recently, a lot of efforts have been spent in order to understand whether technology might represent a key facilitator element for pwID in order to overcome possible barriers and help them to be physically active.

1.4 Why can exergames be helpful?

According to the ICF model, and other theoretical framework investigating pwID and surrounding context, technology can support people in the self-management of chronic conditions. Interestingly, technology has also been included in the 'QoL Supports Model' as a 'Generic Support Components'. Among possible forms of technology, increasing literature is suggesting that active videogames, the so called 'Exergames', are a promising tool for promoting exercise and psycho-physical health in pwID and overcoming the aforementioned barriers. Literally, the word exergaming comes from the words 'exercise' and 'gaming', and refers to playing video games providing also the user with physical exercise (see in next chapters for further discussions). Thanks to an innovative technology, exergames allow users to interact with the environment in a number of ways, including gestures and body movements that are critical for the onscreen play simulation.

Indeed, exergames have been demonstrated to be capable of improving pwID's QoL in a number of ways by stimulating their physical activity. Although further research is necessary, exergames have been proven to be useful to overcome the aforementioned barriers that might hamper pwID from being physically active. First of all, exergames propose games requiring physical activity in a way that may appear funny, engaging and motivating for the single person. This can produce several benefits, motivating pwID to reduce their sedentary style, with a number of positive secondary effects, such as decreasing the

prevalence of obesity while enhancing aerobic activity. Notably, exergaming has also shown to be effective at improving motor skills in pwID. Although further research is in need, exergaming has shown promising evidence to improve the level of motor skills, eventually potentiating their functional independence. Interestingly, while they can be physically helpful, they usually do not require high motor skill levels, and it can be further tailored according to the user's needs.

It is worth noting that research on exergames has demonstrated their positive effect not only to promote physical health but also the psychological and cognitive as well. On the one hand, they can be played both alone and with other members of the family or friends, stimulating social inclusion and acceptance. Moreover, exergaming allows pwID who might have less possibility of exercising and engaging in physical activity, due to the lack of family support, social networks, inclusive environment and few personal resources, to be more active and connected with other persons at a distance. Notably, being physically active and socially engaged when playing has been demonstrated to help pwID to reduce their level of stress, anxiety, and mood disorders. They can also improve the number and quality of everyday activities, reducing the loneliness and social isolation. Research is increasingly demonstrating the effectiveness of exergaming for psychological wellness, including a number of factors such as mental health, the perceptions of competence, self-confidence and self-esteem. On the other hand, exergaming has also been demonstrated as a valuable and supportive instrument to stimulate cognitive functions (attention, memory, executive

function). Hence, since ID often exhibit cognitive impairments, the possibility to perform cognitive stimulation by exergaming might help to promote mental health in an attracting and engaging activity by reducing possible risk factors associated with a not stimulating cognitive life-style. In sum, for pwID to be engaged in a dual task (i.e., both physical and cognitive activity) at the same time with exergaming represents an unparalleled opportunity to engage them in a number of activities whilst stimulating both their physical and psychological health.

Finally, from the technical point of view, they represent a relatively low-cost activity that can be easily tailored according to the specific needs, user preferences and aims of each user. The possibility to implement exergames in touch-screen devices has been proven to have relatively low cognitive demands while being engaging and appealing at the same time. In addition, exergames can be played both in a safe, controlled familiar environment and in an outdoor, more ecological context, thus overcoming possible external constraints when present and allowing pwID to be active.

In sum, thanks to the above mentioned features, exergaming can effectively promote and motivate physical exercise among pwID. Although this research domain is still at an embryonic stage, exergames technology can represent a feasible, dynamic and supportive instrument which can be applied to a huge range of persons according to their specific capacities, needs, preferences and possibilities. As it can be applied both in a domestic-familiar and outdoor context, played alone or with other users,

exergaming technology appears a ductile tool able to manage various needs underlying pwID. In sum, it might really open new possibilities in an unprecedented way to help pwID to overcome a number of barriers helping them to improve their health condition and QoL in a broad sense.

2. THE MOTOR ACTIVITY IN PERSONS WITH INTELLECTUAL DISABILITY

2.1 Definition and guidelines for general population (WHO)

2.2 Muscle-strengthening activities - What counts?

2.3 DOMS: what does it mean?

2.4 How to prevent DOMS?

2.5 Classification of intellectual disability (mild, moderate, severe, profound)

2.6 Motor development and motor condition in pwID

2.1 Definition and guidelines for general population (WHO)

WHO defines **physical activity** as any bodily movement produced by skeletal muscles that requires energy expenditure.
The qualitative aspects of movement are muscle tone (resistance to movement of the muscles), posture (how you hold your body in the space), coordination (the harmony between the different aspects of movement), symmetry, strength, purposefulness, and planning, or praxis (the movements' coordination needed to do something).

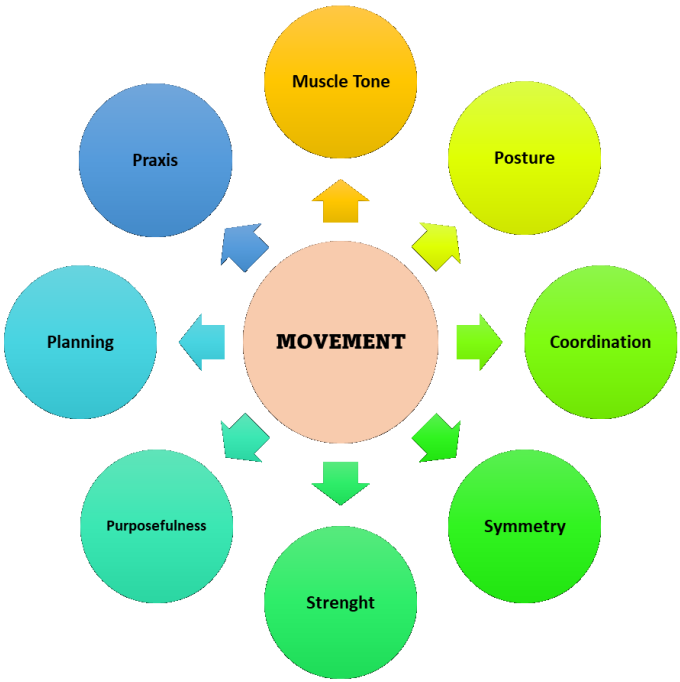


Fig. 2.1: Quality aspects of movement.

A set of combined movements give rise to the exercise that can be classified as *aerobic* or *anaerobic* according to its intensity and the heart rate/breath rate reached during the activity. Both types of exercise are beneficial for a person's health, although each will benefit the body in different ways.

Aerobic exercises are endurance-type exercises that increase a person's heart rate and breathing rate over relatively long durations (eg. brisk walking, running, cycling, swimming).

Anaerobic exercises are exercises that involve short bursts of intense activity and tend to be rhythmic, gentle, of longer duration (eg. sprinting, weightlifting, high intensity interval training).
Anaerobic exercise helps increase muscle mass and strength.

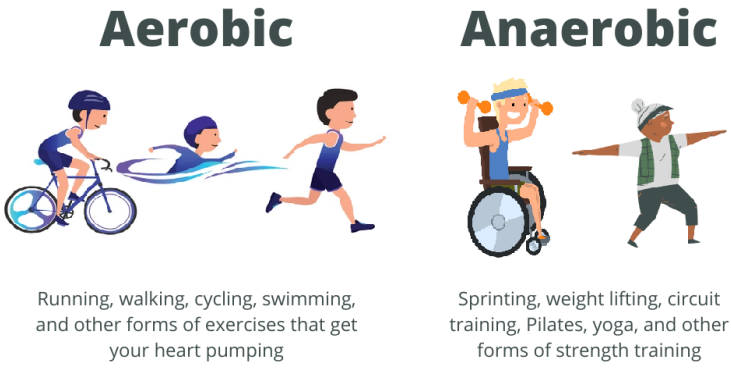


Fig. 2.2: Examples of aerobic and anaerobic exercises.

Many of the health benefits of physical activity for adults also relate to adults living with disability. However, people with ID have poorer health status than the others. Specifically in persons with intellectual disability, motor activity may **also** improve physical function like training space exploration, increasing walking endurance, having more balance, avoiding the fall risk and doing easily and quickly the activities of daily living.

Remember: doing something is better than none!

Precisely for the reasons set, adults should move more and sit less throughout the day. In fact, adults who sit less and do any amount of moderate-to-vigorous intensity physical activity gain some health benefits.

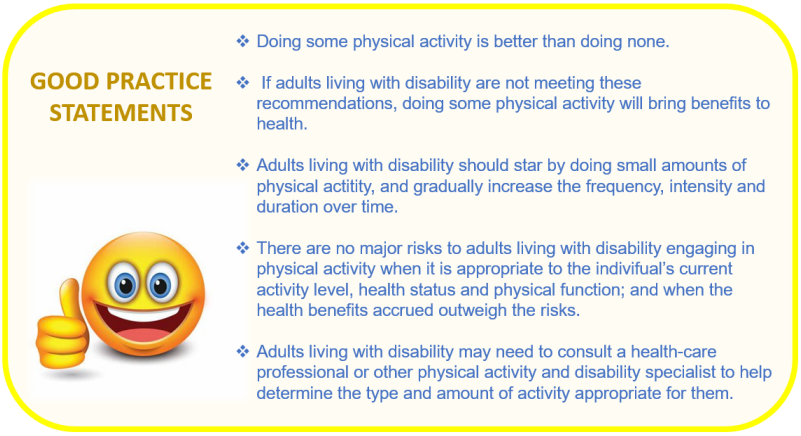


Fig. 2.3: Good practice statements.

WHO (World Health Organization) recommends that adults and adults living with disability should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits. Adults should do muscle-strengthening activities and they may increase the amount of physical activity for additional health benefits.

In the following tables there are some examples of physical activities related to their intensity.

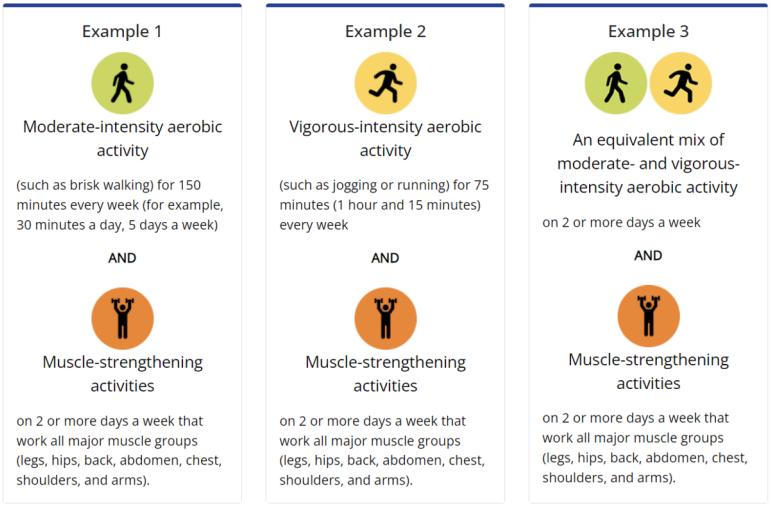


Fig. 2.4: How to plan physical routine week according to the intensity of each activity.

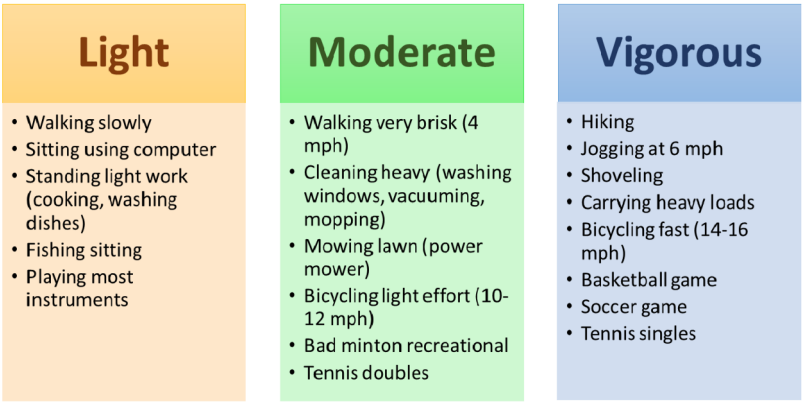


Fig.2.5: Examples of light, moderate and vigorous - intensity activity for healthy adults.

2.2 Muscle-strengthening activities - What counts?

Physical activities to strengthen muscles are recommended at least 2 days a week, in addition to the aerobic activity, and they should work all the major muscle groups of the body: legs, hips, back, chest, abdomen, shoulders and arms.
Doing muscle strengthening on the same or different days of the aerobic training is irrelevant, whatever works better for the person.
To gain health benefits, it is recommended to do muscle-strengthening activities to the point where it's hard doing another repetition without help. A repetition is one complete movement of an activity, like lifting a weight or doing a sit-up. It's recommended to do 8-12 repetitions per activity, which counts as 1 set and to do at least 1 set of muscle-strengthening activities. To gain even more benefits, do 2 or 3 sets.

There are many ways to strengthen the muscles, whether it's at home or the gym. Some activities to train the strength of the muscles are:

- Lifting weights
- Working with resistance bands

- Doing exercises that use your body weight for resistance (e.g., push-ups, sit-ups)
- Heavy gardening (e.g., digging, shovelling)
- Some forms of yoga

Fig. 2.6: WHO guidelines on physical activity and sedentary behaviour (WHO, 2020).

2.3 DOMS: what does it mean?

During exercise the contracting muscles generate force or power and heat, so physical exercise is a form of mechanical energy. This generated energy will deplete the energy stocks within the body. Depending on the form of exercise, sooner or later sensations of fatigue and exhaustion will occur.
However, during physical activity, the pain should not be felt, although a certain degree of suffering is normal due to muscle fatigue, the workloads applied and using muscles that are not usually recruited. The pain may manifest itself acutely (so in this case, it should be recommended to stop) or progressively due to increasing the intensity, the duration of exercise, and so on. The person may get a burning sensation in the muscles or a metallic taste in the mouth if the intensity is high.

Moreover, many diseases speed up the depletion of the energy stocks within the body, amplifying the effect of energy stock depletion that accompanies exercise. In addition, many diseases produce a change of mind-set before exercise that can create sensations of fatigue and exercise-avoiding behaviour at the onset of an exercise.

After strenuous or unusual physical activity, muscle pain and stiffness occur. This condition is called DOMS.
DOMS, Delayed Onset Muscle Soreness, is a familiar experience for the majority of people. It's happened to everyone to feel leg pain after a trekking or arm pain after hard work: this pain is called DOMS.

Symptoms can range from muscle tenderness to severe debilitating pain depending on the intensity and the duration of the activity.
DOMS consists in a temporary damage and inflammation of the muscles that peaks between 24-72 hours. It generally gets better on its own after a few days to a week. However, during that time range of motion and muscle performance can be reduced.

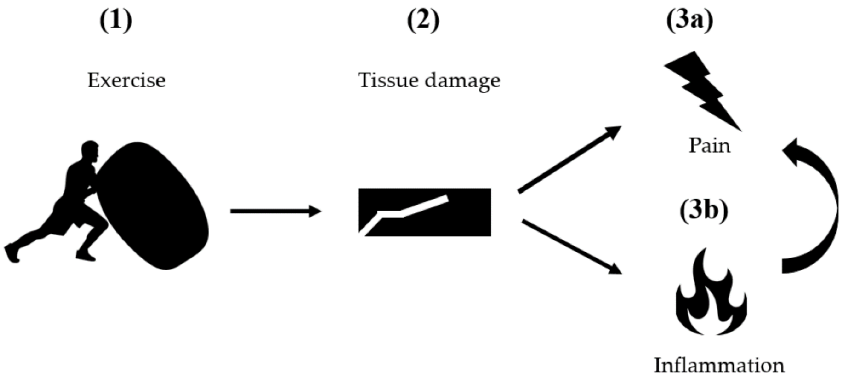


Fig. 2.7: Wilke J, Behringer M. Is "Delayed Onset Muscle Soreness" a False Friend? The Potential Implication of the Fascial Connective Tissue in Post-Exercise Discomfort. Int J Mol Sci. 2021 Aug 31;22(17):9482. doi: 10.3390/ijms22179482. PMID: 34502387; PMCID: PMC8431437.

2.4 How to prevent DOMS?

There are no specific remedies for DOMS symptoms. Cryotherapy, stretching, homoeopathy, ultrasound and electrical current modalities have demonstrated no effect on the alleviation of the symptoms but anaerobic exercise can temporarily alleviate the pain.

However, it's possible to prevent the DOMS by planning a specific physical activity routine. For example, novel activities should be introduced progressively over a period of 1 or 2 weeks at the beginning in order to reduce the level of physical impairment. Moverover, increasing the intensity of the exercise a little at a time gets the muscles used to the new load without producing damage and inflammation and consequently pain.

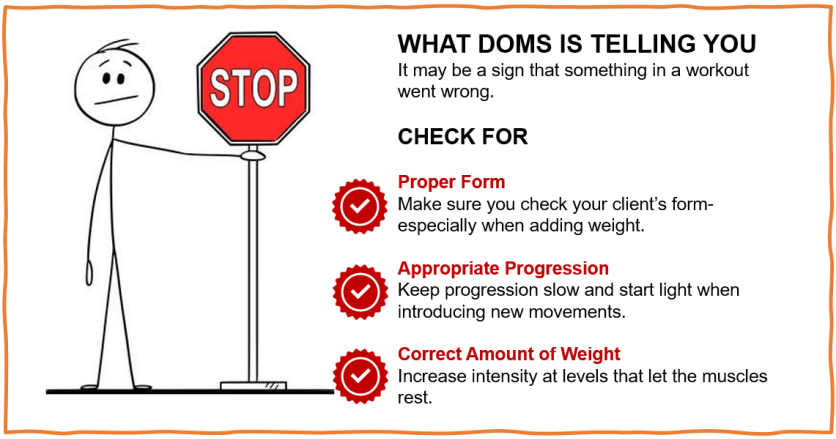


Fig. 2.8: What DOMS is telling you.

2.5 Classification of intellectual disability (mild, moderate, severe, profound)

The American Association on Intellectual and Developmental Disabilities (AAIDD) defines ID as "intellectual disability is characterised by significant limitations both in intellectual functioning and adaptive behaviour as expressed in conceptual, social, and practical adaptive skills."
The intellectual disability severity can be classified in "mild", "moderate", "severe" and "profound".

Mild intellectual disability

About 85 percent of pwID are classified as having mild intellectual disabilities and many even achieve academic success. Individuals with mild ID are slower in all areas of conceptual development, social and daily living skills; they are able to blend in socially. These individuals can learn practical life skills, which allows them to live independently with minimal levels of support.

Moderate Intellectual Disability

About 10 percent of pwID are classified as having moderate intellectual disability. They have noticeable developmental delays and may have physical signs of impairment. They can travel to familiar places in their community, and learn basic skills related to safety and health. Their self-care requires moderate support.
People with moderate intellectual disability have fair communication skills, but cannot typically communicate on complex levels. They may have difficulty in social situations and problems with social cues and judgement. These people can care

for themselves, but might need more instruction and support than the typical person. Many can live in independent situations, but some still need the support of a group home.

Severe Intellectual Disability

Only about 3 or 4 percent are classified as severe ID, with major delays in development. Individuals often have the ability to understand speech but otherwise have limited communication skills, they can only communicate on the most basic levels. Despite being able to learn simple daily routines and to engage in simple self-care, individuals with severe ID cannot successfully live an independent life and will need to live in a group home setting.

Profound Intellectual Disability

Only about 1-2 percent have profound intellectual disability. They often have congenital syndromes with significant delays in all areas. These individuals cannot live independently and they require close supervision and help with self-care activities. They have very limited ability to communicate and often have physical limitations. Individuals with profound ID are more likely to have associated medical conditions than those with mild or moderate ID.

2.6 Motor development and motor skills in persons with ID

Persons with ID have established motor development delays. This delay refers to a person who has not gained the developmental skills expected, compared to others of the same age. Motor function in pwID could be characterized by muscle stiffness in arms and legs, inability to stand up and to balance, limitations in postural control, gait and joint flexibility.
The poor motor performance is believed to be caused also by their impaired intellectual capabilities. Furthermore, exclusion from physical activity hinders a child's physical, psychological, and social development and can have a negative influence on future sports participation and physical activity.

Moreover, this motor condition causes important impairments in adaptive functioning and daily living skills that limit their autonomy and independence as well as their participation in social activities.

Motor and social interaction skills are needed in order to perform purposeful activities in daily life. In fact, activities of daily living are influenced by well-developed motor skills that serve as building blocks for the development of more complex motor and sports-specific skills.

Several studies have reported that motor problems and low motor proficiency are associated with negative consequences such as the avoidance of physical activity, obesity, lack of concentration, low self-esteem, poor academic performance, and poor social competence.

The practice of physical activity is one of the most powerful tools that exist to avoid all these negative consequences, improve motor skills and, in general, improve the quality of life and integration of pwID.

Fig. 2.9: Physical activity for disabled adults infographic.UK Chief Medical Officers' Physical Activity Guidelines (2019).

3. PHYSICAL ACTIVITY: WHAT DO WE MEAN?

3.1 Main concepts of physical activity

3.2 The strength training session

3.3 Physical exercise routine (example)

3.4 Building a physical activity routine for pwID

3.5 Monitoring physical exercise – The Talk Test, the Rating of Perceived Exertion (RPE) Scale (Adapted) and alternative forms of effort assessment for nonverbal individuals

3.6 General precautions to consider

3.7 Tips for Promoting Physical Activity and communication strategies

3.8 Everyday Physical Activities

3.9 Benefits of recreational physical activities

3.10 Exergames: literature review on exergaming and physical activity in pwID

Physical activity is essential for good health and well-being, and this is especially true for pwID. However, planning physical activities for individuals with intellectual disabilities can be challenging, as they may have unique needs and challenges that require special attention. In this chapter we will explore the benefits of some activities for pwID, the specific needs and considerations for this population, and strategies for creating a safe, effective, and enjoyable physical activity plan.

3.1 Main concepts of physical activity

Before analysing how to build and monitor a training, it is important to discuss some basic concepts of physical exercise.
Basic concepts such as metabolic intensity (aerobic or anaerobic), exercise threshold, sets, repetitions and rest are the foundation for building the workout, while heart rate and workout's intensity are commonly used to monitor the training.

The metabolic intensity

Aerobic and anaerobic exercise are two different types of physical activity that involve different energy systems and have distinct benefits and risks.
Aerobic exercise refers to physical activity that requires oxygen to produce energy. This type of exercise is characterized by low to moderate intensity and sustained physical activity, such as jogging, cycling, swimming, or dancing. During aerobic exercise, your heart rate and breathing rate increase, and your body uses oxygen to produce energy for your muscles.

The benefits of aerobic exercise include improved cardiovascular health, increased endurance, better lung function, reduced risk of chronic diseases such as diabetes and heart disease, weight loss, and improved mood and cognitive function.

However, there are some risks and considerations to take into account when performing aerobic exercise. If you overdo it or have underlying health issues, you may experience muscle soreness, joint pain, or other injuries. It's important to start slowly and gradually increase your intensity and duration of exercise, stay hydrated, and listen to your body.

Anaerobic exercise, on the other hand, is a type of physical activity that doesn't require oxygen to produce energy. This type of exercise is characterised by high intensity and short duration, such as weightlifting, sprinting, or jumping. During anaerobic exercise, your body uses stored energy sources, such as glycogen, to produce energy for your muscles.

On a scale of subjective perception of intensity, the anaerobic threshold would be around 7 out of 10.

The benefits of anaerobic exercise include increased muscle strength and power, improved bone density, increased metabolism, and better overall athletic performance.

However, there are also some risks and considerations to take into account when performing anaerobic exercise. Overexertion or improper technique can lead to muscle strains, sprains, or tears, as well as joint pain or other injuries.

It's important to warm up properly, use proper technique, and gradually increase your intensity and weight over time.

In summary, both aerobic and anaerobic exercise offer unique benefits and risks. Incorporating a combination of both types of

exercise into your fitness routine can help you achieve a well-rounded, healthy lifestyle.

Heart rate

Heart rate refers to the number of times your heart beats per minute. It's an important measure of cardiovascular fitness and can be used to monitor the intensity of your exercise. For example, during aerobic exercise, you may aim to maintain your heart rate within a target range to achieve the most benefits.

Intensity

Intensity refers to the level of effort you exert during exercise. The intensity of an exercise can be measured in different ways, such as by heart rate, perceived exertion (using a rating scale), or by the amount of weight lifted. Intensity can be adjusted to increase or decrease the challenge of the exercise.

Sets, repetitions, and rest in strength training

In strength training, a set refers to a group of repetitions (reps) of a particular exercise. Repetitions refer to the number of times you perform an exercise in a set.

Rest refers to the time between sets or exercises.

The number of sets, repetitions, and rest time can vary depending on your fitness goals and the exercise you're performing. For example, if you're aiming to build muscle strength and size, you may perform 3-5 sets of 8-12 repetitions with 1-2 minutes of rest between sets. However, if you're aiming to improve muscular endurance, you may perform 2-3 sets of 15-20 repetitions with shorter rest periods.

It's important to vary your sets, repetitions, and rest time to avoid plateauing and to continue to challenge your body. It's also important to use proper technique and gradually increase the weight you're lifting over time to avoid injury.

Exercise thresholds

Exercise thresholds refer to specific points during exercise where certain physiological changes occur. For example, the anaerobic threshold is the point at which your body switches from using primarily aerobic metabolism to anaerobic metabolism. Understanding your exercise thresholds can help you optimize your training and improve your performance.

3.2 The strength training session

Strength training sessions can be organized in different ways, depending on an individual's goals and preferences. Here are some common methods:

Super sets: This involves performing two exercises back-to-back with little to no rest in between. Super sets can target different muscle groups or the same muscle group, and they can be used to increase the intensity of the workout.

Tri-sets: Tri-sets are similar to super sets, but they involve performing three exercises back-to-back.

Circuits: In a circuit, there are a series of exercises in a specific order with little to no rest in between. Circuits can be designed to target specific muscle groups or to provide a full-body workout.

The recommended duration of a strength training session depends on the goals and fitness level. Generally, a session should last 30-60 minutes. The number of exercises to include in the workout also depends on the same variables, but a typical session might include 5-10 exercises.

The main muscle groups to work during a strength training session include the chest, back, shoulders, arms, legs, and core. It's important to target each muscle group evenly to avoid muscle imbalances and injuries.

In what concerns the order of exercises, a common approach is to work larger muscle groups first (such as legs or chest) and smaller muscle groups last (such as biceps or triceps). This allows you to use your energy and strength more efficiently.

The number of sets, repetitions, and rest time also depends on the person's goals. For example, if one's aiming to build strength

and muscle size, might perform 3-5 sets of 8-12 repetitions with 1-2 minutes of rest between sets. If one's aiming to improve muscular endurance, might perform 2-3 sets of 15-20 repetitions with shorter rest periods (30-60 seconds).

Overall, it's important to vary workouts and use proper technique to avoid injuries and maximize results.

Annex I and Annex II show two examples of exercise routines, one organised as a circuit and the other with supersets.

3.3 Physical exercise routine (example)

It's important to note that the exercise routine should be tailored to the individual's needs and abilities. A healthcare professional or a qualified physical therapist should be consulted before starting any exercise routine.

Here is an example of a basic physical exercise routine that can be adapted to an individual's needs and preferences:

Warm-up (5 minutes): Begin with some light stretching exercises to help warm up the muscles.

Cardiovascular exercise (10-15 minutes): Engage in a low-impact aerobic exercise such as walking, cycling, or using an elliptical machine, for 10-15 minutes.

Strength training (10-15 minutes): Use resistance bands or light weights to perform simple exercises like arm curls, leg lifts, and seated presses, for 10-15 minutes.

Balance and coordination exercises (10-15 minutes): Engage in activities that promote balance and coordination, such as standing on one leg, walking heel-to-toe, or practising gentle yoga poses.

Cool-down and stretching (5 minutes): End the routine with some gentle stretching exercises to help cool down and prevent injury.

It's important to remember to adjust the routine as needed and to gradually increase the duration and intensity of the exercises over time. The individual's healthcare professional or physical therapist can provide guidance on how to safely and effectively modify the routine to meet the individual's needs and goals.

3.4 Building a physical activity routine for pwID

To build a physical activity routine for pwID, it's important to take into account their individual abilities and needs. Here are some general suggestions that can help create an appropriate physical activity routine for this population:

1. Think about consulting a healthcare professional: it's important to consult a healthcare professional, such as a doctor or physiotherapist, to assess the specific needs of the person with intellectual disabilities and create a suitable physical activity program for them.

2. Choose suitable activities: It's important to choose activities that are appropriate for the person's abilities and interests. Activities such as walking, dancing, cycling, and swimming may be good options.

3. Adapt the physical activity: Some activities may need to be adapted to meet the individual needs of the person with intellectual disabilities. For example, if the person has balance problems, support equipment may be needed to help them perform the activity safely.

4. Create a safe environment: Make sure the area where the person will be exercising is safe and free of obstacles. If necessary, put down non-slip mats, remove hazardous objects, and ensure that the lighting is adequate.

5. Involve a coach or instructor: An experienced coach or instructor can help adapt the activities and provide guidance and motivation during the physical activity routine.

6. Set realistic goals: Setting realistic goals can help maintain motivation and progress. For example, instead of focusing on performance goals, such as running a marathon, set activity-based goals, such as walking 30 minutes a day.

7. Track progress: Keeping a record of progress can help the person with intellectual disabilities see their progress and stay motivated. This may include recording frequency, duration, and intensity of activities.
A useful tool to plan a routine of exercises could be the **Physical Activity Pyramid**.

The physical activity pyramid is a graphic representation of the recommended levels of physical activity for a healthy lifestyle. It shows the different types of physical activities and the recommended amounts of each to improve health.

The physical activity pyramid can vary depending on different sources and countries, but it typically consists of horizontal layers with different types of physical activities.

The bottom layer, which is the largest in size, is made up of the most recommended types of physical activities and should be done more frequently, while the top layer represents the least recommended types of physical activities and should be done less frequently.

The base of the pyramid is typically made up of low-intensity aerobic activities, such as walking, cycling, and dancing, that should be done daily for at least 30 minutes to improve cardiovascular and respiratory health. Above that are muscle-strengthening activities, such as strength training and flexibility exercises, that should be done at least two days a week.

At the top of the pyramid are activities like watching TV, playing video games, and other sedentary activities, which should be limited and reduced to promote an active and healthy lifestyle.
The physical activity pyramid is a useful tool to help people understand the importance of different types of physical activities in a healthy routine and can be used as a guide to plan a physical activity routine that is appropriate for each individual's needs.

Fig. 3.1: The new Physical Activity Pyramid for Teens. C.B. Corbin, from Fitness for Life, 7th ed. (Champaign, IL: Human Kinetics, 2021).

Understanding the Specific Needs of pwID

pwID may have unique needs and challenges when it comes to physical activity, such as limited mobility, sensory issues, or communication difficulties. It's essential to assess the individual's abilities, interests, and support needs to determine the most appropriate physical activities. Working with healthcare professionals, caregivers, and family members can be useful for developing an accurate assessment.

Setting Goals and Creating a Plan

The physical activity plan should be tailored to the individual's needs, abilities, and support needs. It is necessary to set achievable goals for physical activity and create a plan that takes into account the individual's interests and preferences. Also, the plan must be adaptable so that any progress can be tracked, and changes can be made if necessary.

Adapting Activities and Equipment

pwID may benefit from adaptations to activities or equipment to ensure that they are safe, accessible, and enjoyable. There are different types of adaptations, such as modifications to the rules of a game or the use of specialized equipment. It's important to find what works best for each individual and adjust the adaptations accordingly.

Collaboration with Healthcare Professionals and Support Staff

Working with healthcare professionals and support staff can be critical to ensure that physical activity is safe and effective. Collaboration with healthcare professionals, caregivers, and family members can help to ensure that physical activity is appropriately monitored and adjusted as necessary. These professionals may have valuable expertise, such as occupational or physical therapy or mental health services.

Tips for Promoting Physical Activity

Encouraging pwID to engage in physical activity can be a challenge, especially if they face barriers such as lack of motivation or social isolation. Incorporating social activities, providing positive reinforcement, and making it fun and enjoyable can promote physical activity. Finding activities that the individual enjoys, such as dancing or swimming, is also essential.

3.5 Monitoring physical exercise – The Talk Test, the Rating of Perceived Exertion (RPE) Scale (Adapted) and alternative forms of effort assessment for nonverbal individuals

The **Talk Test** is a simple and effective method for determining the intensity of physical exercise based on a person's ability to speak during exercise. This test can be used by individuals of any fitness level and does not require any special equipment. To perform the Talk Test, a person should try to speak out loud during exercise. If they can speak comfortably without getting out of breath, it means the exercise intensity is light to moderate. If the person has difficulty speaking but can still maintain a conversation, the intensity is moderate to vigorous. If the person can only speak a few words at a time, the exercise intensity is vigorous to intense. The Talk Test is a simple way to monitor exercise intensity without the need for complicated equipment or calculations. However, it is important to remember that the test is only an estimate, and other measures such as heart rate may be necessary to determine exercise intensity more accurately.

The Rating of Perceived Exertion (RPE) Scale, also known as the Borg Scale, is a method of subjectively assessing the perceived effort or fatigue during physical exercise. This scale consists of a list of numbers from 6 to 20, where each number represents a degree of perceived effort, ranging from "no effort" (6) to "maximal effort" (20).

How exhausting is your exercise?		
6		
7	very, very light	
8		
9	very light	
10		
11	quite light	
12		
13	somewhat exhausting	
14		
15	exhausting	
16		
17	very exhausting	
18		
19	very, very exhausting	
20		

Fig. 3.2: Borg Scale. Link: DOI:10.3390/cancers14061468.

During physical exercise, the individual should choose the number on the scale that best reflects their degree of effort or fatigue. For example, if the person chooses the number 12, it means they are experiencing moderate effort.

The Borg Scale can be used to monitor the intensity of physical exercise and adjust it according to the individual's perceived

exertion. It is useful for people of all fitness levels and can be used for various types of activities, including walking, running, swimming, and cycling. It is important to remember that the RPE Scale is subjective and may vary between individuals. Therefore, it is recommended that the person use the scale regularly to become familiar with their own levels of effort and fatigue.

In the case of individuals with intellectual disabilities, this scale should be adapted for better use and understanding of the exercise participant. This adaptation should include, among other things, a reduction in the number of items available to be chosen, more visual communication, and images easily related to the intensity of effort (example: smiley faces).

Alternative forms of effort assessment for nonverbal individuals

Assessing effort during physical exercise in individuals who do not speak can be challenging, but there are some alternatives to the Subjective Effort Scale (SES) or the Talk Test that can be used.

One option is heart rate (HR) assessment, which is an objective indicator of exercise intensity. HR is usually measured with a heart rate monitor, which can be worn by a person during exercise. Exercise intensity can be adjusted according to the target heart rate, which can be calculated based on age, physical fitness level, and exercise goal.

In the case of individuals who cannot tolerate the placement of a heart rate monitor during exercise, another option may be pre-

and post-activity assessment using an oximeter. This option is less invasive and provides information about HR and blood oxygen saturation.

Another option is observing the person's breathing during exercise. Breathing can be assessed by observing the frequency, rhythm, and depth of breaths. Faster and deeper breathing may indicate greater effort, while slower and shallower breathing may indicate less effort.

It is also possible to assess the person's physiological signals, such as sweating, body temperature, and blood pressure. These signals can be monitored using specific equipment or by observing the person's physical signals.

Finally, effort assessment in nonverbal individuals may require careful observation of other nonverbal cues, such as facial expression, motor behaviour, and body posture. An experienced coach or healthcare professional may be able to assess effort based on these nonverbal indicators.

3.6 General precautions to consider

Regular physical exercise brings many health benefits for both individuals with intellectual disabilities and those without. However, it is important to consider some precautions to ensure the safety and well-being of these individuals during exercise. Some of these precautions include:

Medical evaluation: It is important for a person with an intellectual disability to be evaluated by a physician before starting any exercise program to determine which activities are safe and appropriate for them.

Exercise adaptation: Physical exercise activities should be adapted to the abilities and needs of the person with an intellectual disability. This may include modifying equipment or using specific exercises to work on certain skills.

Supervision: It is important for a person with an intellectual disability to be supervised by an experienced coach or healthcare professional during physical exercise. This can help ensure that the person is performing exercises correctly and avoiding injuries.

Communication: Communication with the person with an intellectual disability is crucial to ensure their safety and well-being. The coach or healthcare professional should be aware of any communication limitations and adapt their language and communication techniques to ensure that the person understands instructions.

Hydration: The person with an intellectual disability may have difficulty recognizing the feeling of thirst or may have coordination issues that make accessing water difficult. Therefore, it is important to encourage and monitor hydration during physical exercise.

Sensitivity: It is important to keep in mind that individuals with intellectual disabilities may have special needs or individual preferences, such as the need for frequent breaks or a preference for specific exercises. The coach or healthcare professional should be sensitive to these needs and adapt the exercise program accordingly.

3.7 Tips for Promoting Physical Activity

Encouraging pwID to engage in physical activity can be a challenge, especially if they face barriers such as lack of motivation or social isolation.

Motivating a person with intellectual disabilities to engage in physical activity can be challenging, but there are several strategies that can be helpful:

Find activities that are enjoyable: pwID may have a better time staying engaged in physical activity if they enjoy the activity. Try to find an activity that the individual finds fun or interesting, such as dancing, swimming, or playing games.

1. Create a routine: establishing a consistent routine, also by using symbols, pictures etc, can help individuals with intellectual disabilities develop the habit of physical activity, making it easier to continue over time.

2. Break down the activity into manageable steps: For some individuals with intellectual disabilities, the activity may seem overwhelming or too difficult. Break the activity down into smaller, more manageable steps to help them build their confidence and feel a sense of accomplishment.

3. Use positive reinforcement: Rewarding individuals for engaging in physical activity can be a powerful motivator. Praise them for their effort and progress, and provide small rewards to encourage them to continue.

4. Set goals to keep them focused and motivated: having a concrete goal can give the right motivation to complete the activity. For example, scheduling a lunch on the top of the hill during a trekking.

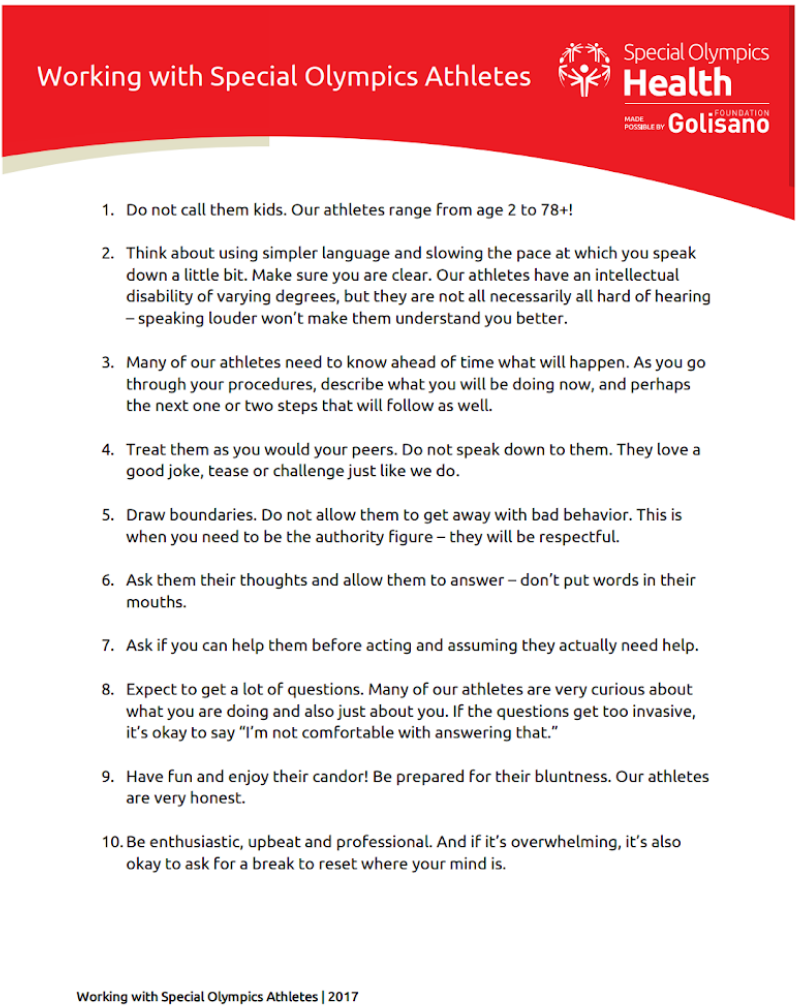
5. Try to plan with them the next activity: what is going to happen now? In order to make them feel more comfortable.

6. Involve family and friends: Encourage family and friends to participate in physical activity with the individual, which can help to create a supportive and fun environment.

7. Consider a peer mentor: Pairing the individual with a peer mentor who is also engaged in physical activity can help provide motivation and encouragement.

8. Make adaptations: Sometimes, the physical activity may need to be adapted to meet the needs of the individual with intellectual disabilities. For example, using specialized equipment, modifying the rules of the game, or adjusting the intensity of the activity can make it more accessible and enjoyable.

It's important to remember that every person is unique, and what works for one person may not work for another. Be patient and persistent, and keep trying different strategies until you find what works best for the individual.



Working with Special Olympics Athletes

Special Olympics Health

MADE POSSIBLE BY Golisano FOUNDATION

1. Do not call them kids. Our athletes range from age 2 to 78+!
2. Think about using simpler language and slowing the pace at which you speak down a little bit. Make sure you are clear. Our athletes have an intellectual disability of varying degrees, but they are not all necessarily all hard of hearing – speaking louder won't make them understand you better.
3. Many of our athletes need to know ahead of time what will happen. As you go through your procedures, describe what you will be doing now, and perhaps the next one or two steps that will follow as well.
4. Treat them as you would your peers. Do not speak down to them. They love a good joke, tease or challenge just like we do.
5. Draw boundaries. Do not allow them to get away with bad behavior. This is when you need to be the authority figure – they will be respectful.
6. Ask them their thoughts and allow them to answer – don't put words in their mouths.
7. Ask if you can help them before acting and assuming they actually need help.
8. Expect to get a lot of questions. Many of our athletes are very curious about what you are doing and also just about you. If the questions get too invasive, it's okay to say "I'm not comfortable with answering that."
9. Have fun and enjoy their candor! Be prepared for their bluntness. Our athletes are very honest.
10. Be enthusiastic, upbeat and professional. And if it's overwhelming, it's also okay to ask for a break to reset where your mind is.

Working with Special Olympics Athletes | 2017

Fig. 3.3: Working with Special Olympics Athletes.

3.8 Everyday Physical Activities

Physical activity doesn't mean only exercises and workout, but it also refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work. Both moderate and vigorous intensity physical activity improve health. Popular ways to be active include walking, cycling, swimming, dance, exploring, wheeling etc. However, people could also stay active by doing recreation and play, by doing actions of everyday life like walking to market for food shopping, walking outside to throw out the garbage, to take the dog out or by doing other household activities. All these activities can be done at any level of skill and for enjoyment by everybody.

When it comes to daily tasks, pwID can have some issues with planning and executing what they need to do. For example, going to the supermarket by themselves can be challenging and also scary if they haven't ever done it before. Another example could be cleaning and or cooking something. In fact, these activities require a plan and cognitive skills such as problem solving, attention, monitoring and flexibility, that sometimes may not be fully developed in this population. So, it is important to educate, teach and give adequate support to help them enhance their skills, in order to empower them to be more independent and active. One way to accomplish this is to encourage the creation of this new activity in their routine because it might be easier to engage them in something known and predictable. Another aspect to consider is the significance of the activity: the more the task is enjoyable and important, the more the person is willing to do it!

3.9 Benefits of recreational physical activities

Being active in small ways throughout the day can make a big difference.

There are lots of everyday and recreational activities that provide an opportunity to be active and provide health benefits as shown below.

Fig. 3.4: Recreational physical activities examples.

Walking: regular brisk walking can help to maintain a healthy weight and lose body fat.

It prevents or manages various conditions, including heart disease, stroke, high blood pressure, cancer and type 2 diabetes. Regular walking helps people to improve balance, coordination, cognition, memory, sleep and to increase the strength of the bones and the muscles. Moreover, it improves muscle endurance and also increases energy levels. And finally, it reduces stress and tension.

Social Dancing: the benefits of Dance include stress-reduction, cardiovascular health and a positive social environment. But that's not all. According to the Stanford University Dance Division, a study was conducted to see if any physical or cognitive recreational activities influenced mental acuity. What they found was that of all cognitive and physical activities examined (from tennis and swimming to reading and crossword puzzles) frequent dancing scored the highest with a whopping 76 percent risk reduction for dementia. Dancing integrates several brain functions at once — kinesthetic, rational, musical, and emotional — further increasing your neural connectivity.

Ping pong: it provides a great cardiovascular workout and improves reflexes and core tone; it improves joint mobility of both upper and lower extremities and helps to increase energy over time. And because it depends on eye-hand coordination and rapid thinking, it is highly stimulating to brain activity.

Bowling: not only bowling burns around 240 calories per hour, but it also strengthens and tones upper-body muscles, improves heart and respiratory fitness, and increases endurance while maintaining bone density.

Roller-skating: offers a broad workout for many of the body's muscles, as well as providing great stretching and cardiovascular benefits. Skating burns nearly 500 calories per hour.

3.10 Exergames: literature review on exergaming and physical activity in pwID

The benefit of physical activity has been widely discussed in the previous chapters.
Individuals with disabilities usually embrace a sedentary lifestyle that can lead to the appearance of health problems such as cardiovascular diseases, diabetes, obesity, and depression.
There are multiple reasons that cause this behaviour (see above chapter 1), one is the lack of motivation to participate in physical activity programs since they do not fully understand the benefits of exercise. Adults with intellectual disabilities (ID) and physical disabilities often experience limited opportunities to participate in leisure activities and in sport. A solution to this problem could be using technology that, according to literature, may support individuals for self-managing chronic health issue. A type of technology that could be useful is exergame.
The term "exergames" or "exergaming" first appears in Collins dictionary (2007) and is used to determine the combination of gaming with exercise (Di Tore & Raiola, 2012). Exergames are innovative games developed within an interactive environment for the user. They combine exercise with gaming, hence their name, exergames (exercise and games) (Sinclair et al., 2007). Exergames demand physical activity aiming to be part of virtual sports or interactive physical activities. The person has to accomplish body movements according to the simulation game shown on the screen.
Exergames have been envisioned for promoting physical activity. In fact, they can be challenging for individuals with disabilities

and may be useful as an alternative exercise program to improve the fitness level and motor ability (Silva et al., 2017). Moreover, exergames may serve to broaden their repertoire of accessible leisure activities, but sometimes they require some specific help and training by specialised personnel or the support of peers or caregivers.
According to Tan et al. (2016) exergames can be divided into three categories:

1. Living-room exergames such as Nintendo Wii (Kyoto, Japan) that require the user to perform exercise routines including dancing, aerobics, yoga etc.

2. Cardio machine exergames like Fish Game played on a rowing machine, with specific training equipment. Some exergames in this category contain virtual reality.

3. Mobile exergames with accelerometers, global positioning systems to track physical activity of the user and affect gameplay.
Although excessive video game play has been noted in the literature as a contributor to childhood obesity in the normal population, exergaming has been designed to capitalise on the reinforcing effects of video games to increase physical activity in children. This type of video game promotes an active and dynamic lifestyle (Marasso, D. 2015). Thanks to the guidance of the body movement combined with biofeedback, the person using exergame explores many movement strategies by trial and error. In this way the user is guided until he or she completes the level. In addition, the neuromotor training influences the brain

plasticity, modifying or creating new motor patterns. Indeed, the body and mind are deeply connected.

Additionally, the effects of exergame on cognitive skills emerged in the last few years and according to the literature they can also improve scholastic performances. Some cognitive skills might be stimulated by exergames like for example attention, spatial awareness and cause effect relationship (Höysniemi, J. 2006). Another aspect that is influenced by using this type of video game is the social interaction. Some studies demonstrated that the use of it in group contests enlarged the relationship between peers and prevented social isolation (Mueller, F., Agamanolis, S., & Picard, R. 2003).

A growing body of literature has studied the effect of exergames in pwID and there is some evidence of their positive effect on this population. From these studies emerged that music-based video can influence the engagement in physical activity. During activity with music, the heart rate increases and it may exhibit more body movement patterns that are relevant to energy expenditure during exergaming sessions. Moreover, the music may produce a distraction effect during exercise and lower the perception of fatigue (Yamashita et al. 2006). Further the enjoyment was identified, so exergaming could be a pleasant and enjoyable activity for pwID.

4. THE ROLE OF ICT FOR PROMOTING PHYSICAL ACTIVITY

4.1. An overview on the need of developing exergames

4.2. What have been the approaches so far?

4.3. Technologies and approaches for promoting exercise

- Serious Games
- Exergame
- Mobile Assistive Technology (Apps)
- Wearables
- Augmented reality
- Guided Exercises
- Telemetry

4.4. Criteria to choose and use technology in exergames

- Accessibility
- Security & privacy
- Usability

4.5 Examples of possible solutions

- Proposal 1: Study with wearable devices
- Proposal 2: Exergame management panel for centers
- Proposal 3: Expansion of the MOVE-IT project

4.1 An overview on the need of developing exergames

According to the statistics of the World Health Organization (WHO), some groups in society have more significant struggles than others getting the recommended amount of physical activity. One of these groups is people with Intellectual Disabilities (ID), which have different functioning resulting in different needs in terms of facilitation, accessibility, and usability (Einarsson et al., 2015). Many within this group have a sedentary lifestyle, often resulting in health problems such as obesity, diabetes, and cardiovascular disease (Segal et al., 2016).

Among the reasons of this low activity levels we can find several barriers for individuals with ID to be in physical activity: lack of resources for necessary support; reduced physical and behavioural skills; and lack of available programs (Kuijken, Naaldenberg, der Sanden, & de Valk, 2016) . As a solution to the problems, it is suggested to investigate successful methods for encouraging physical activity for individuals with ID (Sundblom, Bergstrom, & Ellinder, 2015)suggesting a better use of theory from intervention designs on community-based settings(Heller, Fisher, Marks, & Hsieh, 2014) .

Health-related video games are effective for shifting behavioural changes and promote health with influencing health determent activity (Baranowski et al., 2016). Active video games, also known as exergames, have been investigated and found to be promising

for individuals with ID (Mat Rosly, Mat Rosly, Davis OAM, Husain, & Hasnan, 2017). Combining aspects of games with learning real-life skills and behavior change show promise in providing an entertaining platform for obtaining such skills and behaviors. Multiple applications utilizing gamification elements have been developed to promote increased PA (physical activity) levels for the general population. However, these applications have not been systematically been adopted by persons with ID as they tend to be too complex to use. There is also limited knowledge of the effects such applications would impose on persons with ID. Still, some research has been explicitly aimed at providing a platform for persons with ID to increase their PA levels.

With technology rapidly evolving and becoming part of everyday life, these applications aim to increase motivation for physical activity in the form of an application for mobile and tablets. Here the user engages in exercise within a game environment containing motivational factors, rewards and competition. To turn the tide, this project introduces new approaches that will benefit people with ID by facilitating and making modern technology like mobile devices more accessible for this group.

4.2 What have been the approaches so far?

Several studies have identified barriers that cause individuals with ID to have low levels of physical activity (Bossink, van der Putten, & Vlaskamp, 2017). Lack of motivation is emphasized as one of the reasons for not being physically active (Dixon-Ibarra, Driver, Vanderbom, & Humphries, 2017) and is related to that they do not understand the benefits of exercise. Other barriers that were pointed out were a lack of options for physical activity and programs aimed for individuals with ID (van Schijndel-Speet, Evenhuis, van Wijck, van Montfort, & Echteld, 2017); or that physical activities were too difficult or boring. Besides, the preparation, skills and motivation of the staff working at institutions or day care centers for persons with ID has demonstrated to have a positive impact (Engeset, Söderström, & Vik, 2015).

In addition to revealing the barriers, the studies also make suggestions on how to facilitate all these barriers. Van Schijndel-Speet et al. stated in their study that it would be beneficial to increase staff knowledge on physical activity and available options of physical activity and materials (van Schijndel-Speet et al., 2017). Rewards and being praised for performance in forms of feedback, medals, or awards, has proven to be a promising way to give interest in physical activity for individuals with ID (Michalsen et al., 2020).

Exergaming, also known as active video games (AVG), is defined as a video game that requires body movements to control the game (Benzing & Schmidt, 2018). In contrast to regular video games, exergaming promotes both exercise and a video gaming at the same time (Baranowski et al., 2016) . Several terms are used for exergames, such as "active video games," or "interactive video games," and is also defined as "Any type of video games/multimedia interactions that require the game player to move physically" (Oh & Yang, 2010). Exergames have been involved in several intervention studies that investigate the health-related benefits of using exergames (Stanmore, Stubbs, Vancampfort, de Bruin, & Firth, 2017).

The objectives for using exergames are heterogeneous in the recent scientific literature; whereas some studies looked on increasing physical activity (Chang, Shih, & Lin, 2014; Davison et al., 2016; Finkelstein, Barnes, Wartell, & Suma, 2013; Serna et al., 2015), other studies had a focus on a form for motor coordination control (Caro, Tentori, Martinez-Garcia, & Alvelais, 2017; Vazquez, Cardenas, Cibrian, & Tentori, 2016). The most thorough testing was conducted by Davison et al. (Davison et al., 2016) where they were able to test an exercise program involving exergames on over 109 students for a year. However, these test participants had developmental disorders that do not come under the qualification of ID, which weakens the relevance of the results for MOVEIT project. Another interesting study, executed by Chang et al. (Chang et al., 2014) proposed exergames on two

individuals with ID in ten series of three minutes session over five days. They concluded that the intervention had a positive effect on increasing physical activity. Anyhow, it is very important to choose the technology that fits our goals and, importantly, that makes users feel as much as comfortable.

4.3 Technologies and approaches for promoting exercise

■ Serious Games

Games are a highly popular leisure activity with a central focus on entertainment. Even though there is a significant variation between the various available games, they typically consist of presenting a series of challenges to the player, for which the player is rewarded on completion. Serious games aim to utilize the entertaining aspects of games (gamification) to provide a platform for learning real-life skills and imposing behavioral change. The application domain for serious games is many, including education, healthcare, and business.

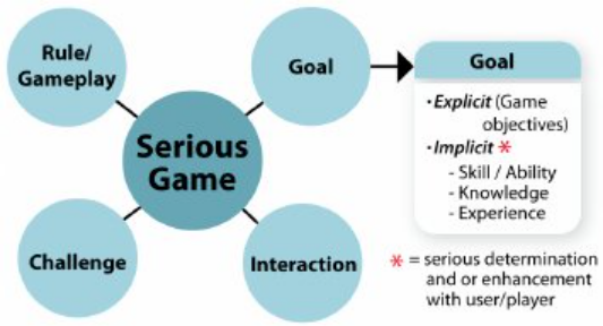


Fig. 4.1 Serious game components (Wattanasoontorn, Boada, García, & Sbert, 2013)

- **Exergame**

Exergames are a subcategory of serious games which focuses mainly on physical activity interventions (Kappen, Mirza-Babaei, & Nacke, 2019). Exergames also aims to integrate gamification aspects to provide an entertaining and motivating platform for increasing physical activity levels. Conducted research shows potential for exergames to increase physical activity levels.

Exergames are designed to be engaging and entertaining, combining exercise with the enjoyment of playing a video game. This entertainment factor can motivate individuals to stay active for longer periods. Many exergames provide real-time feedback on performance, such as calories burned, heart rate, or points earned. This feedback can help users track their progress and stay motivated. Some exergames offer multiplayer modes or online connectivity, allowing players to compete or collaborate with others, fostering social interaction and a sense of community.

- **Mobile Assistive Technology (Apps)**

An increase in the use of mobile assistive technology for people with ID has been celebrated as the most substantial benefactor to the rehabilitation of people with ID. Assistive technology designed to remove as many of the boundaries that might be considered a hindrance to people with impairments.

Several studies indicate that by implementing assistive technology for people with id has a positive effect and can alleviate difficulties such as impaired memory or attention deficit disorder.

Use of a mobile assistive technology has proven to have the following advantages for people with ID:

- Lasting benefits: Some cases show good results in memory exercise, even when the devices were taken away.
- The portability and size of mobile and tablet devices are the appropriate size for everyday use.
- In everyday use, people with ID prefer the use of electronic devices. They are considered more effective than traditional methods, and the user finds them more entertaining and comfortable.
- The use of electronic devices gives the user more independence and make them feel included and involved in current trends.

Fig. 4.2. Pletora of mobile apps

■ Wearables

A wearable device in the context of physical activity promotion is a piece of technology that individuals can wear on their bodies to monitor and track various aspects of their physical activity and health. These devices are designed to encourage people to engage in more physical activity, make healthier lifestyle choices, and achieve their fitness goals. Wearable devices typically use sensors and data processing capabilities to collect information about the wearer's movements, heart rate, sleep patterns, and other relevant data.

For the shake of the MOVEIT project, we herein recommend some common features and functions of wearable devices for physical activity promotion:

- **Activity Tracking**: Wearables can monitor steps taken, distance traveled, and calories burned throughout the day. They provide users with real-time feedback on their activity levels and progress toward daily goals.
- **Heart Rate Monitoring**: Many wearables incorporate heart rate sensors to track a user's heart rate during exercise and rest. This information can help users optimize their workouts and gauge their overall cardiovascular health.
- **Sleep Tracking**: Some devices can track sleep patterns, including the duration and quality of sleep. This data can help

users understand their sleep habits and make improvements for better rest.

- **GPS and Location Tracking**: Wearables with GPS capabilities can provide information about routes, pace, and elevation during outdoor activities like running or cycling.
- **Calorie Counting**: Wearables often estimate calorie expenditure based on activity and heart rate data. This information can be helpful for those looking to manage their weight.
- **Goal Setting and Progress Monitoring**: Users can set specific activity goals and track their progress over time. Achieving milestones can provide motivation to stay active.
- **Notifications**: Some wearables can display smartphone notifications, making it convenient for users to stay connected without needing to check their phones during workouts.
- **Health Metrics**: Advanced wearables may include additional health monitoring features such as stress tracking, oxygen saturation (SpO2) measurement, and skin temperature measurement.

These devices are commonly worn as wristbands, smartwatches, or clipped onto clothing. They sync with smartphone apps or desktop software to provide users with comprehensive insights into their physical activity and health. By promoting awareness and engagement in physical activity, wearable devices can play a valuable role in supporting a healthier lifestyle.

■ Augmented reality

Augmented Reality (AR) is a technology that overlays digital information, such as images, videos, 3D models, or other virtual elements, onto the real-world environment. AR blends the physical and digital worlds, enhancing the perception of the real world by adding computer-generated content or data. Unlike virtual reality (VR), which immerses the user in a completely simulated environment, AR enhances the existing environment by adding virtual elements to it. For example:

- **Real-time Interaction:** AR is typically interactive and provides real-time feedback, allowing users to interact with the virtual elements and the real world simultaneously.
- **Marker-Based and Markerless**: AR can be marker-based, where it relies on specific markers or triggers (like QR codes or image recognition) to activate virtual content, or markerless, where it uses the device's sensors (such as GPS, cameras, and accelerometers) to determine the user's location and orientation.

AR experiences can be delivered through various hardware devices, including smartphones, tablets, smart glasses, headsets, and wearable displays and AR has a wide range of applications across industries. It can be used in gaming, navigation, education, healthcare, architecture, interior design, marketing, and more.

Some common examples of AR applications include Pokémon GO, which overlays virtual Pokémon creatures onto the real world using a smartphone's camera; AR navigation apps that provide real-time directions by overlaying arrows and markers onto streets; and AR apps for trying on virtual clothing or visualizing furniture in your home.

Figure 4.3. Exaample of augmented reality

AR technology has evolved significantly in recent years, becoming more accessible and widespread due to the proliferation of smartphones and tablets equipped with cameras and sensors. It has the potential to revolutionize how we interact with and perceive the world around us, offering new and innovative ways to engage with digital information and content in our daily lives.

■ Guided Exercises

Feedback and guidance for physical activity are essential components in helping individuals engage in effective and safe exercise routines. Whether you are working out on your own or with the assistance of a fitness professional, feedback and guidance can contribute to better performance, motivation, and injury prevention. Here are some key aspects of feedback and guidance for physical activity:

1. Form and Technique Correction:

- **Visual Cues**: Instructors or training partners can provide real-time feedback on your exercise form and technique, ensuring you are performing movements correctly.
- **Mirror Observation**: Mirrors in gyms or exercise spaces allow individuals to self-assess their form and adjust.
- **Video Analysis**: Recording your workouts and analyzing them later can help identify areas for improvement in form and technique.

2. Motivational Feedback:

- **Positive Reinforcement**: Encouragement and praise from trainers, workout partners, or even fitness apps can boost motivation.
- **Progress Tracking**: Seeing improvements in strength, endurance, or body composition can be highly motivating.

Keeping records of your workouts and achievements can provide a sense of accomplishment.

3. Biometric Data Feedback:

- **Heart Rate Monitoring**: Tracking your heart rate during exercise can help you stay within your target heart rate zone for specific goals (e.g., fat burning, cardiovascular fitness).
- **Calorie Expenditure**: Estimates of calories burned can provide feedback on the intensity and effectiveness of your workouts.
- **Distance and Speed**: Feedback on distance covered and speed during activities like running or cycling can be motivating and help you set goals.

4. Guidance on Exercise Progression:

- **Program Progression**: Fitness professionals can design workout programs that gradually increase in intensity and complexity to ensure continuous improvement.
- **Variation**: Guidance on incorporating variety into your workouts can prevent boredom and plateaus in progress.

5. Safety Instructions and Warnings:

- **Warm-up and Cool-down**: Guidance on proper warm-up and cool-down routines can reduce the risk of injury.

- **Safety Tips**: Instructions on using exercise equipment safely and avoiding common mistakes are crucial for injury prevention.
- **Rest and Recovery**: Learning about the importance of rest, sleep, and recovery in between workouts can prevent overtraining and burnout.

6. Goal Setting: SMART Goals: Setting Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) goals with guidance from a trainer can help you stay focused and motivated. Feedback and guidance can come from various sources, including personal trainers, workout partners, fitness apps, wearable fitness devices, and online resources. The key is to use feedback and guidance to make informed decisions, continually improve your physical activity routines, and stay committed to your fitness goals.

■ Telemetry

Telemetry in the context of fitness, especially with devices like ergometer bikes, refers to the wireless transmission of real-time data and measurements from the fitness equipment to a remote receiver or display unit. This technology allows users to monitor and analyze various fitness-related metrics and performance data during their workout without the need for wired connections.

Here are some key aspects of telemetry for fitness, specifically in the context of ergometer bikes:

- Wireless Data Transmission: Telemetry systems in ergometer bikes use wireless technologies like Bluetooth, ANT+, or Wi-Fi to send data from the bike's sensors to a compatible display device. This device can be a smartphone, tablet, fitness watch, or dedicated fitness console.

- Performance Metrics: Ergometer bikes equipped with telemetry capabilities can provide users with real-time data on various performance metrics, including:

- Heart Rate: Users can monitor their heart rate to gauge the intensity of their workout and ensure they stay within their target heart rate zones.
- Speed and Distance: Information on current speed and total distance traveled during the workout.
- Cadence: Pedal cadence (revolutions per minute) data helps users optimize their pedaling technique.

- Power Output: Some advanced ergometer bikes measure power output in watts, which is particularly useful for serious cyclists and athletes.
- Calories Burned: An estimate of the calories burned based on the user's exertion level.

- Data Logging and Analysis: Telemetry-enabled fitness equipment often records workout data, which can be later analyzed for performance improvement. Users can track their progress over time, set goals, and adjust their workouts accordingly.

- Integration: Telemetry systems in fitness equipment may be compatible with fitness apps and platforms, allowing users to sync their workout data with these applications for more in-depth analysis and tracking. This integration can enhance the overall fitness experience.

Telemetry-equipped ergometer bikes and other fitness equipment aim to enhance the user's workout experience by providing valuable data and insights. These systems can be especially useful for individuals who are serious about their fitness routines and want to track their progress, optimize their workouts, and stay motivated.

4.4 Criteria to choose and use technology in exergames

- **Accessibility**

Every citizen has the right of producing and sharing information (every time it does not cause a law infringement), and depending on the target user, this information will have to be provided with particular characteristics to be reachable and understandable. Accessibility is defined as the degree to which all people can use an object, visit a physical place or access to a service regardless the cognitive, physical and technical capabilities.

The new United Nations agenda on the Sustainable Development Goals reinforces the idea of equality for a sustainable development in the Goal nº 4."Quality education".

Moreover, in the New Delhi Declaration this statement is more evident:

"*Universal access to information and knowledge, through technologies of information and communication (ICT) and auxiliary technologies, in equality of conditions with others, it is for people with disabilities a right inalienable human life and a precondition for living independently and participate fully and on an equal footing in society.*"

With respect to the technologies included in this book, it is very important to take into consideration accessibility issues. Users have to be able to navigate through the screens and interfaces with independence, regardless their level of cognitive/sensitive impairment (e.g.: unable to understand, unable to read). The evaluation to of the accessible content in educational context is elaborated through three principles:

- Representation (What): It refers to the form in which the information is displayed to the user, like texts, sounds, pictures, schemas, etc.

- Expression (How): Allows the users to interact with the information and show what they have learnt according to their capabilities

- Participation (Why): The reason of the knowledge construction and the active and participative learning.

Every single user is unique, and that is specially important with the type of end-users of the MOVEIT project. Any type of material, app or software we want to use in the design and implementation of physical activity programs should be accurately revised by the instructors/monitors prior to the activity to check a possible accessibility issue. Some of the activities may involve searching apps in repositories, browsing interesting portals or just playing. When the educator wants to use this as a resource for the session or even for leisure, it is convenient to explore all the sites in advance to the users.

- Guide the users by offering two or three apps they can start to look for information. We strongly recommend to start with Sorterius and AGA.

- When possible, the educator should be together with the user and take enough time to analyze the app, evaluating if he/she is able to:

  - Read the heading/subheadings of the app.
  - Look the pictures and images in the app.
  - Identify the required information.
  - Verify the relevant multimedia materials.

- Games are always an attractive resource. The educator must guide the user during the activity to frame it in an educational context.

The Web Accessibility Initiative (WAI) developed by the W3C is an international community that develops recommendations and web standards to ensure that the world wide web (Internet) is accessible and understandable for all. The objective of the WAI is to facilitate access for people with disabilities, through the development of accessibility guidelines, improving the tools for their evaluation and repair, through of an educational and awareness work in relation to the importance of accessible design of websites. These principles can be easily transferred to the use of apps, in such a way that the content acccessibility guidelines

suggest that these type of interfaces must respond to four principles:

- **Perceptibility:** the information and interface components are presented to the user in a way in which he/she can perceive them, regardless of his sensory abilities.
- **Understandability:** It refers to the fact that both the information and the handling of the user interface must be understandable.
- **Operability:** the interface and navigation components must function in such a way that the user can navigate the content smoothly and independently, regardless of the device you use and the speed of use.
- **Robustness:** the content and operation of the website must be as robust enough to be interpreted by a wide variety of devices, including assistive technologies.

■ Security & privacy

The safe use of ICTs among people with intellectual disabilities is of concern. For this reason, several organizations have launched initiatives to ensure that when they sit in front of a computer, smartphone or tablet, they do not take risks. The development of accessible materials that inform them about the responsible use of the Internet or social networks has been the first step. But what are the risks that people with disabilities face when faced with new technologies? How to avoid them?

The continuous upgrade and evolution of technologies make hard to identify any possible risk related to the use of technologies, however, there is a list of key risk that appear when persons with ID use technology:

- Smartphones: The main risk is related to mobile spending on calls, messages or Internet connection, so bill and charges should be reviewed weekly, and in the case of prepaid phones, be sure there is not a high amount of credit. It is extremely easy to fall into unwanted expenditures when downloading apps, or playing with freemium licenses.

- Internet: A quarter of people with intellectual disabilities who have a connection to the Internet at home do not use it because of their parents' "distrust or prejudice" that "they may cause some damage to the equipment or download a computer virus,"

among other situations. Regarding the problems, there is an excess of information and technicalities, few security controls, non-adapted content or excess advertising.

- Undesired behavior and coercion: Some applications include the ability to interact with other people remotely. This interaction can be through a chat or sharing the screens of a game. Great care must be taken with the interactions carried out through these games, since there are documented frauds of hackers who try through social engineering to gain the trust of people with intellectual disabilities to extract information and use it for their own profit or to threaten. It is not bad to establish virtual relationships, but users must be supervised and educated on the guidelines and behaviors to follow in these applications (do not share personal data, do not share bank details, do not provide the phone number/email address or physical address, etc...)

Faced with the risks, several organizations have planned actions to raise awareness and training in the safe use of new technologies and the promotion of responsible digital citizenship. The ultimate goal is to make the messages simple so that people with intellectual disabilities understand them. And there are few accessible materials, which is why we want to facilitate training in the responsible use of the Internet, social networks and

smartphones so that they understand concepts such as identity theft, data protection or rectification mechanisms.

[SPANISH MATERIAL] A video produced by Down Association in Madrid has included content on responsibility when sharing data with other people, control of emotions, tolerance and participation and solidarity. These actions help prepare informed, connected citizens with strategies to solve the problems and needs of today's society.

■ Usability

In the context of ICTs, the usability refers to the extent to which a digital product, system, or technology can be easily and effectively used by its intended users to achieve their goals efficiently, with satisfaction, and without undue frustration. Usability is a critical aspect of designing and evaluating software applications, websites, and other digital interfaces like apps. It focuses on ensuring that technology is user-friendly and provides a positive user experience.

Regarding the usability of apps for persons with ID, there are some kay aspects which should be considered:

1. **Learnability**: How easy it is for users, especially new users, to learn how to use the technology and its features. Intuitive and well-organized interfaces contribute to high learnability.
2. **Efficiency:** The speed and accuracy with which users can complete tasks using the technology. Efficient interfaces reduce the time and effort required to achieve specific goals.
3. **Memorability**: The extent to which users can remember how to use the technology after some time has passed since their last interaction. Memorable designs allow users to return to the technology and easily pick up where they left off.

4. **Error Prevention and Handling**: The ability of the technology to prevent errors or, in case errors do occur, provide clear and helpful error messages to guide users in correcting their actions.
5. **Satisfaction**: User satisfaction is a subjective measure that assesses how much users enjoy using the technology. A positive user experience often leads to higher satisfaction.
6. **Accessibility**: Ensuring that the technology is usable by individuals with some kind of sensitive impairment, such as those with visual, auditory, or motor impairments. Accessibility features are crucial for providing equal access to ICTs.

The fairly new **EN-ISO TS 82304-2 Health informatics – Part 2 Health and wellness apps – Quality and reliability** aims to define quality and reliability criteria that help application developers to design and app users to select better mobile apps. Compliance with the criteria results in a score that is reflected in a label inspired by the energy label used in Europe.

There are thousands of health and wellness apps, and without any medical knowledge, these apps can be downloaded and used. However, there are also concerns about the security and reliability of many of these applications. Building on existing international initiatives and ISO and IEC standards, the European Commission has commissioned the development of a

Technical Specification for quality and reliability requirements for health and wellness applications.

Usability testing, user feedback, and user-centered design methodologies are commonly used to evaluate and improve the usability of ICT products and systems. By prioritizing usability, persons with ID will use apps that are more user-friendly, which can lead to increased adoption, reduced support costs, and improved overall user satisfaction.

4.5 Examples of possible solutions

Co-design sessions were held in centers where people with intellectual disabilities work, in the following context: " *exergame customization strategies for the promotion of physical activity of people with intellectual disabilities* ."

Based on the document where the results of these sessions are summarized, several possible proposals can be extracted:

- **Proposal 1: Study with wearable devices**

This proposal is based on the collection and processing of data related to physical activity (number of steps, weight) through the use of *wearable devices* (smart watch, scale). A research study would be carried out, in which conclusions would be drawn based on the data collected. The study would be carried out in a center where people with intellectual disabilities are worked with.

This would have the objective of ascertaining whether the use of *exergames* with personalized strategies implies an improvement in physical activity levels in people with intellectual disabilities, but with a more complex set of data to support this hypothesis (if it is correct).

This proposal would align with results from co-design sessions in that participants commented that having accurate real-time data

(mainly the number of steps) would motivate them more when doing the exercises.

To do this, it would be necessary to implement the proper connections with the bracelet and scale services to collect the data and send it to the project's own servers. This implementation would vary depending on the company and the model that was implemented to do this.

Developer guide for connecting with *FitBit* brand bracelets: https://dev.fitbit.com/build/reference/web-api/developerguide/

Similar projects

An advantage when carrying out MOVE-IT is the expertise of the UPV in the LIFECHAMPS project, in which a very similar study was carried out. In that case, a *FitBit* brand bracelet and a *Withings* brand scale were used to record the number of steps and weight for 3 months as part of a research project to measure the quality of life of cancer patients during their treatment in a hospital.
A member of UPV worked in the installations and uninstallations, where he prepared the bracelets and scales and linked them to the patients' mobile phones, in addition to connecting a series of services created by an external collaborator destined to send the data to the servers of the project.

Based on this experience, there were a series of lessons learned that can be taken into account for this project.

The biggest challenge they faced was the multitude of external factors and components, beyond their control, that led to a series of problems:

- Data recording for the bracelet and the scale depends on the services of the two companies that created the products: *FitBit* and *Withings*. This means that if any of these fail at a critical moment, data could be lost.
    - This happened during an uninstallation, in which syncing *FitBit* bracelet data was impossible, which led to a large part of this patient's study data being lost.
        - Syncing errors were likely caused by an issue within *FitBit* 's system, and being an external company, there was no way to report it in time or find a solution.
- As installations were carried out on the patients' mobile phones, the wide variety of devices, in addition to the different environments of the patients (Internet access/ home WiFi connection, for example), posed a problem when collecting data.
    - Some patients' phones synced successfully on a daily basis, while others stopped syncing for weeks or months.
    - In the latter, the only opportunity to sync missing data was during uninstallation. If any external factor prevented the process at that time (service, mobile, Internet errors, etc.), that data could no longer be recovered for the project.
- Furthermore, since most of these problems required access to the patient's cell phone to be reviewed and fixed, in many of

these cases it was necessary to specifically visit each patient who had one of them in person. Each of these patients has a different availability and lives in a different place; Therefore, managing the process of contacting them, setting a date and time, and traveling was complex.

- An important problem that occurred in the middle of the study, during the installations, was that the company *FitBit* was bought by *Google;* and in the process, *Google* changed the account system and forced all new users to have a *Google account* to use the product.

- Since email accounts generated for the project were created using their own email service specifically without user data for privacy reasons, these accounts could no longer be used to create new FitBit accounts to link to the bracelets for any installations after that, since they were not *Google* accounts.
- As email accounts generated by the project were used in its own service specifically without user data for privacy reasons, these accounts could no longer be used to create new FitBit accounts *to* link to the bracelets of the new facilities, since they could not They are *Google* accounts .
- Luckily, since there were only a few installations left to complete the process, it was only necessary to create 3 or 4 *Google accounts* , since the accounts created previously were still valid.
- However, the study involved 50 patients. If this had happened before, creating 50 *Google accounts* is not feasible, since the company has measures to prevent mass account creation. The only option provided by *Google* is to use the *Google Workspace* paid service, focused on businesses.

Another factor that influenced the completion of the pilots were the dates and festivities:

- Part of the pilots occurred during the summer season, with the summer holidays in between.

    - During this time, the availability of patients and workers was reduced. Some patients went on vacation and could not continue with the study, or had to temporarily pause it, or finished just before but were not available to uninstall.

There were some cases in which wearing the bracelet for a long time caused allergic reactions in the patient, which led to them having to remove it.

- The use of cloth straps (rather than the typical plastic ones) was recommended to reduce the possibility of these allergic reactions.

Possible precautionary measures

Taking into account all the lessons learned in this previous project in which *wearables were used* , the following preventive measures could be proposed:

- Have (at least) one person with the time and resources to regularly check (relative to the duration of the study) that all users' data is arriving correctly.
    - This could be a regular process in which, for example, every week a technician and a worker from the center meet to check that the data is arriving, and where the worker tries to refresh the sending process for bracelets with missing data (or even manually write down this data elsewhere to avoid data loss if there are serious problems).
    - The technician could also review this beforehand, and only meet with the worker if data is missing.
- Try to reduce external factors so that they are as few as possible:
    - Luckily, some of the external factors that existed in LIFECHAMPS do not occur here, since:
        - There is a center involved, therefore the environments are more controllable (they are reduced to the rooms or areas of the center).
        - The cell phones would belong to the center or the project, instead of using the patients' personal cell phones, since the *wearables* would only be used within the

center, during the activities, and under the supervision of a professional.

- Regarding factors such as data synchronization and sending services provided by the companies that manufacture *wearables* , it is more difficult to reduce outsourcing here, but there would be several possible mitigations:

  - Carry out a risk analysis, specifying possible solutions to cases such as *FitBit* forcing the use of *Google accounts* , for example.
  - Perhaps have some type of contact with the company, through some collaboration in which if something is published your participation is mentioned, for example.
    - In the case of *FitBit* , perhaps the company itself could have created special accounts for the study if it had been a collaborator, helping us with the Google accounts problem *(* unlikely, but possible).

- Consider whether to pre-install remote assistance software on the study's mobile phones, to facilitate remote problem solving.

- Take into account the dates of the study and coordinate with the center, taking into account festivities and vacations.
- Regarding possible allergic reactions to bracelets:

- Use cloth straps (instead of the typical plastic ones) to reduce the possibility of these allergic reactions.
- Limit the use of bracelets to specific situations with the supervision of a professional, to check if it causes any negative effects on the skin of the participants.

■ Proposal 2: Exergame management panel for centers

The project would consist of the creation of a web system for centers that work with people with intellectual disabilities, so that they themselves can host this system, where the data measured by the *exergames can be collected* .

This proposal would have a social background, since its objective would be to facilitate the connection between people in a center, centralizing data management, and allowing the introduction of motivating elements such as classification tables, group events, etc.

This largely fits with the results of the co-design sessions , since a large part of the requested functionalities either have a social component, or their implementation would imply the creation of a system of this type:

- Leaderboards
- Gamification (points, personal records, etc.)
- Challenge/mission system
- Collaborative events, activities or challenges (cooperative rather than competitive)
- Reminders (optional)

It is true that some participants did not positively value the features that involved other people because they did not find it motivating, but the majority did.

As for reminders, it was a more controversial feature, but if they are shown as optional and the user is given the option to deactivate them, they are welcome.

This type of system could help in the scalability of the project when implementing the model in other centers, although the functionalities must be clearly defined before the development of the application, possibly proposing an iterative model with a series of milestones, acceptance tests , etc.

Furthermore, the connection with *exergames* should be based on an *API* with a standardized system so that future games that could be developed would have a relatively simple way to connect with the system and send their statistics.

These types of projects require a much more extensive initial phase of defining requirements compared to the previous proposal, but they have the possibility of being marketed in the long term, if it seems viable.

■ Proposal 3: Expansion of the MOVE-IT project

This proposal is somewhat related to the previous one, in that the previous proposal could be proposed as an extension of the MOVE-IT project. Additionally, there are some recommended improvements in the results document of the co-design sessions :

- Evaluate the accessibility and usability of *exergames*
    - Simplify user interfaces
    - Reduce the number of visual elements per screen
    - Avoid other distractions
    - Reduce steps from entering the application until starting to play (navigation problems between screens)
- Introduce an adaptive difficulty system
    - Related to the above, some users were not clear about the difficulty levels
        - They didn't know what to decide between "Easy", "Medium" and "Difficult"
    - The difficulty would vary based on the user's progress in the game
        - If you make a lot of mistakes, reduce the difficulty
        - If you get it right too quickly, increase it
    - This depends on the type of game, but other methods could also be considered, such as:
- Enter the weight, and adapt the difficulty to the reported weight

- *If wearables* were used , perhaps the weight could be extracted from there – more complex)

- Include information in *exergames* that allows self-monitoring
    - In particular, the number of steps performed
- Include different gamification methods in *exergames* :
    - Points, achievements, records
    - Activity history
    - Progress, objectives
- Add motivational and emotional management elements

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