“Cutting-Edge Digital Skills for Professional Caregivers of Persons with Disabilities and Mental Health Problems” (DDSKILLS)

HANDBOOK

DDSkills

EQF LEVEL 5

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Project Partners

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Introduction to the Course

The area of disability includes physical, mental, developmental and age-related disorders. People facing these problems encounter several major obstacles, which prevent them from seamlessly integrating in society. Nowadays, more and more of these people have their capabilities (rather than their disabilities) recognised and accepted by the general public. The rapid technological advance of past decades has also triggered a dramatic progress in technology usage for assistive and training purposes.

Since true inclusiveness and deinstitutionalisation process pass through all the professionals involved in the care of persons with disabilities, from the lowest levels to the highest ones, there is an increasing need to integrate existing skills with new approaches and digital competences, able to properly meet these new challenges. New and up-to-date training curricula need to be developed to respond to the needs of care service beneficiaries and properly take advantage of new opportunities offered by technologies.

The DDSkills project aims to develop an alliance for providing new knowledge, skills and competences to Professionals supporting Persons with Disabilities and Mental Health Problems, in line with the dual objective of VET, as defined in the Bruges Communiqué, “contributing to employability and economic growth, and responding to broader societal challenges, in particular promoting social cohesion”.

DDSkills offers a Course Plan consisting of 4 training Units:

1. New Technologies:
    - Assistive Technologies and Aids;
    - Smart Home;
    - Robotics;
    - Augmented Reality, Virtual Reality;
    - Brain-Computer Interfaces; and
    - Green ICT.
2. Self-Advocacy
3. Social Networks’ Development
4. Therapeutic Role-Playing

The developed toolkits are innovative ICT-based training tools, facilitating complex problem solving, increasing trainees’ engagement and fostering deep learning. They are opensource, so that anyone will be able to use them for self-learning purposes.

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How to Use this Handbook

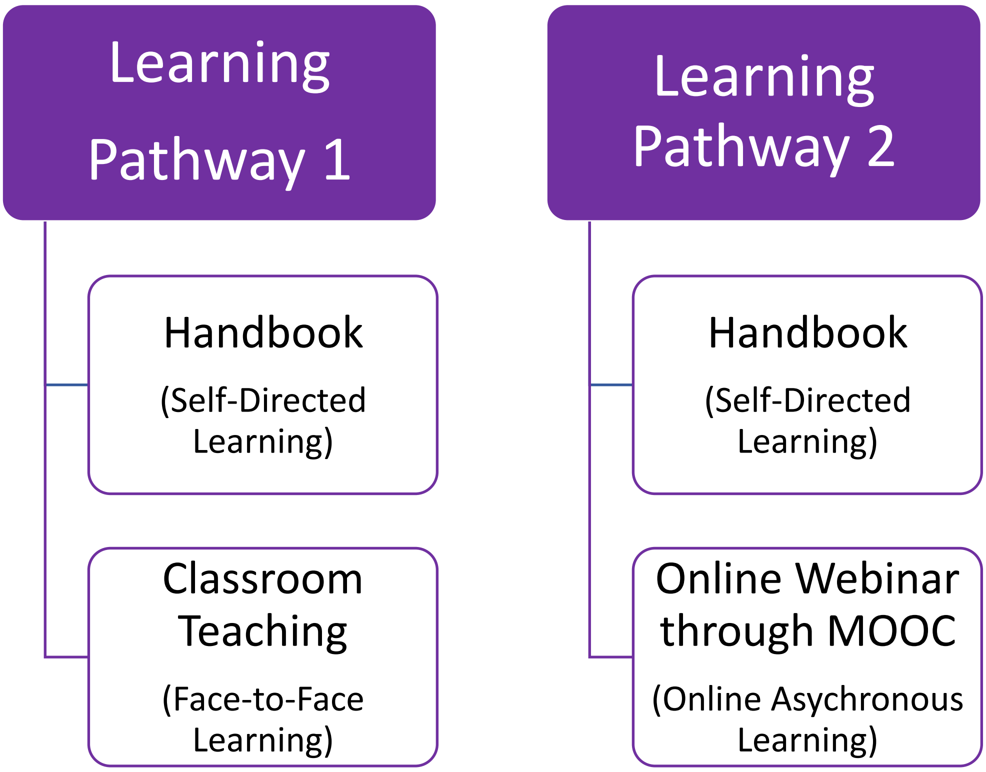
This **Handbook** is the main result of the DDSkills project. It has been structured in a way so as to provide the reader with a clear understanding over the specific training units and enhance his/her skills, knowledge and attitudes.

The **four focus areas** of the Handbook are:

1. New Technologies (Assistive Technology and Aids, Smart Home, Robotics, Augmented Reality, Virtual Reality, Brain-Computer Interfaces and Green ICT);
2. Self-Advocacy and Technology Acceptance;
3. Social Networks' Development; and
4. Therapeutic Role-Playing

The Handbook targets specifically **professionals who support persons with disabilities and mental health problems,** but its input can also accommodate health care professionals in general. It has been developed to give a detailed analysis of the designated units.

A professional can complete the course following **two learning pathways**, as shown on the graphic below:



Both pathways use this **Handbook as a basis**. The study of the Handbook is based on a **self-directed approach**, as professionals are requested to read the Handbook individually. Simultaneously, they can **take the course either by following the first pathway, through**

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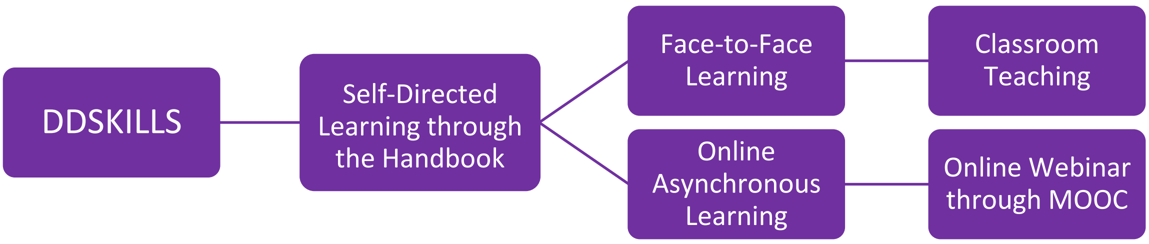
classroom teaching (face-to-face learning) provided by a trainer or by following the second pathway of online asynchronous learning, in an online webinar through MOOC (Massive Open Online Course).

More specifically, the two pathways are designed in a **blended learning way**, so as to provide the professionals with a better understanding of the training units. Having the study of the Handbook as the foundation of the learning process (self-directed learning), the reader can expand his/her understanding through "face-to-face learning" by attending classroom teaching (*Learning Pathway 1*) or through "online asynchronous learning" by taking a MOOC (*Learning Pathway 2*).



Both pathways can prepare the interested professionals for the Final Assessment. The participants who will successfully pass the assessment will be provided with an ISO17024 certification.

This Handbook and the material to be used in the face-to-face or online asynchronous learning will also be certified.

Each unit in the Handbook begins with the sections "Aim", "Learning Outcomes", "Topics", "Key Words" and "Introduction".

Aim:
Each training unit starts with a summary of its aim. This section provides the main objectives of the unit and explains why someone should follow the course corresponding to the specific unit.

Learning Outcomes:
This section acts as a signpost of what a reader can expect to learn from the specific training unit, expressed in terms of acquired *knowledge*, *skills* and *attitudes*.

Topics:
In this section, all the topics of the training unit are listed one after the other, so that the reader knows from the beginning what the specific unit entails.
Key Words:
This section gives to the reader some key words related to the training unit.

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Introduction:
This section is introductory to the main section of the training unit and is developed in a way that it can smoothly engage the reader with the unit and move the reader to the main section.

At this point, the reader will have a brief understanding of the training unit and an explicit idea of what to expect from it.

Once the reader has effectively studied the relevant material of the unit either through face-to-face learning or through online asynchronous learning, s/he can test his/her understanding of the unit through the “Learning Evaluation” section.

Learning Evaluation:

- **Self-assessment Questions:**

The questions of this section are designed so as to test the understanding of the reader on the main concepts of the unit. These questions can also prepare the professional for the **Final Assessment**, so as to get certified with ISO17024.

- **Activities:**

The activities of this section are designed so as to enhance the knowledge of the reader, question his/her understanding of the unit and give examples of the relevant topics. They may be:

- Discussion Boxes
- Open Questions on: Key Concepts/Characteristics/Benefits
- Real-Life Examples
- Case Studies
- Etc.

If the reader fails the self-assessment questions and/or cannot successfully follow the activities of a specific unit, it is recommended that s/he reads this unit in the Handbook again and attends the classroom teaching or the online webinar for a second time. Then, s/he can re-evaluate his/her learning level.

Summary:
In this section, the key points of the training unit are summarised. The idea behind this section is to provide the reader with a revision of the unit, but also to help him/her identify the key concepts of the unit in a quick manner and their alignment with the key words provided at the beginning of the unit.

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UNIT 1: New Technologies

Aim:

The aim of the unit is to provide the learners with background knowledge on new technologies in health and social care, specifically on the topics of assistive technologies, smart home, robotics and green information and communication technology as well as virtual and augmented reality and brain-computer interface. This knowledge should enable learners to identify areas of application in their own working environment and support decision-making to best support clients and promote their participation.

Learning Outcomes:

After completing the course, the learner will be in a position to:

In terms of **knowledge:**

- ✓ Explain the concept of the International Classification of Functioning, Disability and Health (ICF) via the ICF model.
- ✓ Contrast the terms "Assistive Technology" (AT) and "Assistive Product" (AP).
- ✓ Tell the difference between low-tech, mid-tech and high-tech AT.
- ✓ Name specific solutions for vision, hearing, mobility, communication and cognitive impairments.
- ✓ Illustrate the possibilities of Ambient Assisted Living (AAL) applications.
- ✓ Name specific legal requirements of accessibility.
- ✓ Contrast accessible and universal design.
- ✓ List factors that influence AT acceptance.
- ✓ Recall legal basis of data protection.
- ✓ Explain the impact of participatory design on usability.
- ✓ Name main characteristics of smart home.
- ✓ Relate the term smart home to the concept of Ambient Assisted Living (AAL).
- ✓ Name smart home devices from different categories.
- ✓ Recall benefits and concerns of smart home.
- ✓ Label main ways of financing smart home devices.
- ✓ Name fields of robotic application in the health and social care sector.
- ✓ Summarize in which ways robotics can support caregivers.
- ✓ Recall robotic solutions for people with disabilities or functional decline.
- ✓ Tell about the challenges of robotic implementation in private homes and institutions.
- ✓ Describe the architecture of Internet of Things (IoT) solutions.
- ✓ Recall the most common techniques applied to sensors to reduce their power consumption.
- ✓ Name the basic wireless communication protocols and the differences between them.
- ✓ Define and describe Virtual Reality.
- ✓ Define and describe Augmented Reality.

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- ✓ Describe the skills that can be taught using AR and VR.
- ✓ Outline the advantages of using AR and VR when teaching persons with disabilities.
- ✓ Describe the main parts of a VR headset.
- ✓ Describe the different AR/MR devices.
- ✓ Explain the differences between VR, AR and Mixed Reality Applications (Types of interactions, limitations, etc.).
- ✓ Define and describe Brain Computer Interface technology.
- ✓ Explain main applications for BCI technology.
- ✓ Name the main brain signal acquisition methods used for invasive and non-invasive BCIs.
- ✓ Describe electrical signals used to control non-invasive BCIs.
- ✓ Explain how a BCI can be used as assistive technology to support communication and interaction with external world.
- ✓ Explain how a BCI can be used as a rehabilitation tool.

In terms of **skills:**

- ✓ Identify Assistive Technology (AT) for specific use cases on EASTIN.
- ✓ Analyze the process of assistive product provision in their own country.
- ✓ Utilize a programme to check a website for accessibility.
- ✓ Apply guidelines of accessibility on their own web pages.
- ✓ Develop how digital health applications and services influence the AT market.
- ✓ Examine factors of AT acceptance for a specific use case.
- ✓ Apply the MEESTAR as a method to discuss ethical values in specific situations.
- ✓ Develop simplified explications to explain the concept smart home to clients.
- ✓ Identify possible smart home devices clients could benefit from.
- ✓ Estimate the likelihood of financing a smart home device privately or publicly.
- ✓ Discuss the use of smart home in one's own profession.
- ✓ Categorize robotic systems according to their usage.
- ✓ Identify advantages and disadvantages in robotics for rehabilitation.
- ✓ Identify ethical factors that are relevant when implementing robotics.
- ✓ Analyze factors that influence the acceptance of robotic devices.
- ✓ Analyze the power consumption of an IoT device based on its characteristics.
- ✓ Apply specific settings to an IoT device to consume less power.
- ✓ Identify when a device needs a gateway (e.g., mobile phone) to send data to a server.
- ✓ Identify important considerations for persons with disabilities when using VR and AR.
- ✓ Distinguish between VR and AR/MR Equipment.
- ✓ Setup VR equipment.
- ✓ Identify a potential target user for BCI technology.
- ✓ Setup a BCI equipment for simple communication task.

In terms of **attitudes:**

- ✓ Evaluate the possibilities of AT provision for a person's participation in society.
- ✓ Discuss advantages and disadvantages for a specific AT device.
- ✓ Estimate acceptance factors that could influence AT application in a given situation.
- ✓ Evaluate ethical issues and legal requirements.
- ✓ Develop an opinion on smart home according to one's own profession.

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- ✓ Assess ethical concerns of smart home.
- ✓ Assess legal concerns of smart home.
- ✓ Evaluate specific robotic solutions for individual situations.
- ✓ Estimate the current state of robotic solutions to support individuals and institutions.
- ✓ Develop an opinion in which cases robotic devices should be implemented.
- ✓ Evaluate different IoT solutions and select the 'greener' ones of those addressing their needs.
- ✓ Critically appraise the use of VR, AR, and MR by persons with disabilities to learn important skills.
- ✓ Compare the use of AR and VR to facilitate learning.
- ✓ Run VR and AR/MR applications with beneficiaries effectively and evaluate their performance.
- ✓ Manage and supervise other trainers in the use of VR and AR equipment and guide them to the application of respective applications with the beneficiaries.
- ✓ Explain to other trainers and users what a BCI can actually do and what not.
- ✓ Understand which type of BCI can be the most effective for a specific objective/task.

Topics:

- Assistive Technologies and Aids
- Smart Home
- Robotics in the Health and Social Care System
- Green ICT
- Virtual Reality (VR) and Augmented Reality (AR)
- Brain-Computer Interface (BCI)

Key Words:

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• Disability models • Assistive Technology • Assistive product • Accessibility • Universal design • Ambient/Active Assisted Living (AAL) • Digital health applications • Participatory design • Data protection • Acceptance • Ethical aspects • Smart home • Building automation • Smart device • Sensor • Environmental control • Health monitoring • Brain computer interface • P300 • Event-Related potential • Communication	• Multidisciplinary • Independent living • Robot • Service robot • Robotic device • Rehabilitation • Caregiver • Intelligent nursing aids • Logistic and transport systems • Telepresence robots • Emotional robots • Mobility aids • Handling aids • Internet of things • Green ICT • Power consumption • Communication protocols • Virtual reality • Augmented reality • Mixed reality • Social communication • Functional living skills

Introduction:

Digitalisation is playing an increasingly important role in our living and working environments. Digital technologies offer great potentials for people with disabilities or functional impairments in old age as well as for care providers and institutions. They can contribute to increasing autonomy and participation as well as to improve quality of care, safety and security (Klein & Oswald, 2020). For relatives and professional groups, they can relieve physical and mental strains.

In order to be able to offer new digital technologies to clients or to use them in organizations, it is important to know relevant products and systems, but also to be able to assess the consequences for all users. Therefore, this chapter introduces, on the one hand innovative technologies such as assistive technology, smart home applications, robotics, virtual and augmented reality and brain computer interface. On the other hand, additional aspects such application examples, research results, ethical considerations and sustainability issues are described to promote decision-making.

In the first topic, the field of Assistive Technologies (AT) is introduced based on the ICF model of disability (WHO, 2001) starting with an overview and explanations of terms and concepts. Applications for people with specific disabilities are presented and the provision of AT is described. In the course of the chapter, related concepts such as Ambient/Active Assisted Living (AAL),

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Accessibility, Universal Design and Digital Health are described and linked to the field of AT. Furthermore, the factor acceptance, ethical aspects, data security as well as implications for usability are addressed.

The second topic is about smart home applications to support people in independent living. In this chapter, the technology behind building automation and smart devices is explained and specific applications are presented which can support people in old age or with disabilities to stay safe and healthy in their home and to control their environment also, e.g., with mobility constraints.

Robotics in the health and social care system are a rather new topic for most professionals. Therefore, few is known about how clients and professionals could benefit from them and which robotics systems are available on the market. Topic 3 provides information on three areas of application: rehabilitation, robotics to support caregivers and other staff and robotics for support at home.

Regarding ecological aspects, digital technologies such as the Internet of Things (IoT) products have the disadvantage that they consume a lot of energy. When we consider climate change, the challenge is to create 'greener' systems and to choose less energy consuming alternatives when installing new technologies at home or in institutions. Solutions for this challenge are provided in chapter 4.

Chapter 5 is about Virtual and Augmented Reality and skills training: Certain skills and competencies are important for ensuring a good quality of life, positive relationships, social support, and access to various opportunities across the lifespan. Individuals with Developmental and Intellectual Disabilities may require additional support to develop social and functional living skills, in the form of specific teaching or intervention. The advantages of incorporating virtual reality and augmented reality into teaching for these skills and research evidence will be presented. Considerations and recommendations for providing a supportive and beneficial learning experience for individuals with Autism Spectrum Disorder and Intellectual Disabilities will be outlined.

Communication and control of the external environment can be provided via brain–computer interfaces (BCIs) to replace a lost function in persons with severe diseases and little or no chance of recovery of motor abilities (i.e., amyotrophic lateral sclerosis, brainstem stroke). This subject is covered in topic 6. BCIs allow to intentionally modulate brain activity, to train specific brain functions, and to control prosthetic devices, and thus, this technology can also improve the outcome of rehabilitation programmes in persons who have suffered from a central nervous system injury (i.e., stroke leading to a motor or cognitive impairment).

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Topic 1: Assistive Technologies and Aids

1.1: Introduction

The main objective of the chapter is to provide the essential knowledge about assistive technologies and aids as well as socio-technical arrangements for healthcare professionals. The aim is to enable healthcare professionals to address the needs of people with intellectual, mental or physical disabilities or functional decline in old age and contribute to their empowerment for an independent and dignified life with respect to Assistive Technology (AT).

The unit addresses the latest technological advancements in the assisted living domain that can be utilized by people with disabilities and by health professionals to improve their clients’ wellbeing. Therefore, the participants convey an overview of terms, definitions and developments in the area of disability, Assistive Technologies, accessible and universal design, Ambient Assisted Living (AAL) and digital health. Additionally, AT devices for selected impairments are presented. Another objective of this unit is to increase the awareness that Assistive Technologies are part of a complex socio-technical system which has to be understood in order to utilize and maximize benefits and potentials. Therefore, participants also learn about ethical issues, acceptance factors as well as issues of data protection and usability.

1.2: Models and Concepts of Disability

Disability can be viewed from several perspectives and therefore different concepts of disability exist. Three of them are presented in the following section:

1.2.1 Models of Disability

1. The “Medical-model”: Deficit orientated perspective
   - Disability is a person’s problem
   - It is directly caused by disease, trauma or other health condition
   - It requires medical care (individual treatment) by professionals

2. The “Social model”: Social construction
   - Disability is not an individual’s attribute
   - Complex collection of conditions, many created by the social environment

3. “Bio-psycho-social model": balance between medical and social model
   - Functioning and disability as dynamic interaction between health conditions and contextual factors, both personal and environmental (WHO, 2011)

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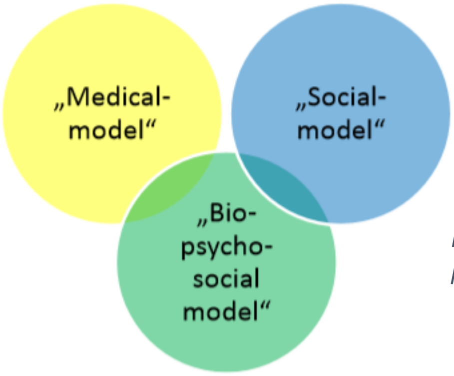

Figure 1: Influence on the bio-psycho-social model of health

Other models of disability can be found under https://www.disabled-world.com/definitions/disability-models.php. The view of each model has consequences for the people concerned.

The World Health Organization (WHO) describes the term disability as follows:

"Disability refers to the interaction between individuals with a health condition (e.g. cerebral palsy, Down syndrome and depression) and personal and environmental factors (e.g. negative attitudes, inaccessible transportation and public buildings, and limited social supports)." (WHO, 2020a).

1.2.2 International Classification of Functioning, Disability and Health (ICF)

The *International Classification of Functioning, Disability and Health* (ICF) from the World Health Organization (WHO, 2001) consist of the bio-psycho-social model of health.

The ICF views human functioning in three levels: "at the level of body or body part, the whole person, and the whole person in a social context" (WHO 2002, 10). The following terms are essential:

- Body Functions: Physiological functions of body systems, including psychological functions
- Body Structures: Anatomical parts of the body such as organs, limbs and their components
- Activity: Execution of a task or action by an individual
- Participation: Involvement in a life situation
- Environmental Factors: Physical, social and attitudinal environment in which people live and conduct their lives

In this context the term *disability* involves dysfunction at one or more of the following levels (WHO, 2001):

- Impairments: Problems in body function or structure such as a significant deviation or loss.
- Activity Limitations: Difficulties an individual may have in executing activities.
- Participation Restrictions: Problems an individual may experience in involvement in life

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situations.

Disability emerges in the interaction between a person's health condition and personal and environmental factors.

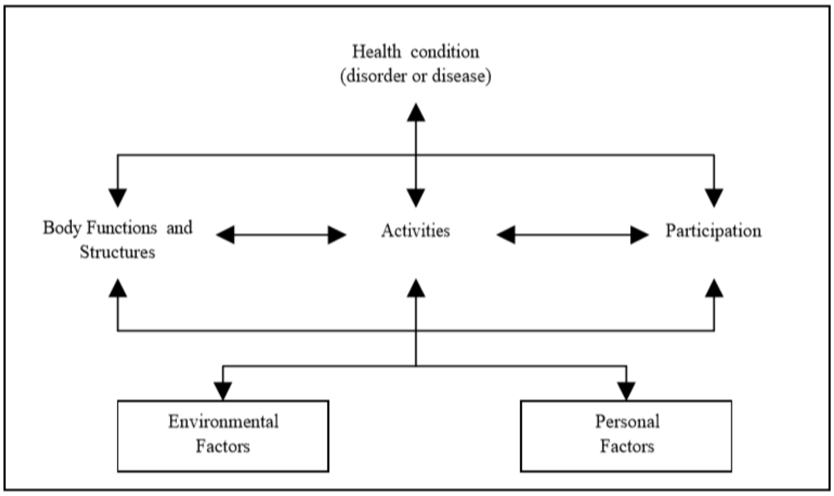

Figure 2: The ICF model (WHO, 2001, p.18)

<u>Example:</u>

A person with a visual impairment (health condition that affects body structures and functions) in a country without an area-wide supply of spectacles (environmental factors) might not be able to learn advanced reading and writing (activities) and therefore not be able gain money in the job he would like to do, even if he/she is motivated (personal factors).

Another person with the same visual impairment who wears well adapted glasses has few constraints in activities and participations.

For further information and practice you can visit the practical manual for using the ICF (WHO, 2013): https://www.who.int/docs/default-source/classification/icf/drafticfpracticalmanual2.pdf?sfvrsn=8a214b01_4

1.3 Assistive Technologies - Terminology and Information Sources

In the following section commonly used terms in Assistive Technology are explained, as well as where to find information on relevant products and services.

1.3.1 Definitions

The World Health Organization defines the term **Assistive Technology (AT)** as:

- "the application of organized knowledge and skills related to assistive products, including

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systems and services. Assistive technology is a subset of health technology." (2016, p. 1)

- "An umbrella term for any device or system that allows individuals to perform tasks they would otherwise be unable to do or increases the ease and safety with which tasks can be performed" (2004, p. 10)

Examples for Assistive Technologies are mobility aids as well as seating and positioning aids, environment control systems, barrier-free living environment and workplace adaptations, prosthetics and orthotics, sensory aids for the hearing impaired and deaf as well as augmentative and alternative communication, but also organizational concepts such as telecare and telehealth (Connell et al., 2008).

There are slightly different definitions and concepts of Assistive Technology on an international level and especially on national levels. Delimitations can be different and new concepts appear through new innovations. This makes it sometimes difficult to classify the terms.

Assistive Products are defined by the WHO as "Any external product (including devices, equipment, instruments or software), especially produced or generally available, the primary purpose of which is to maintain or improve an individual's functioning and independence, and thereby promote their well-being. Assistive products are also used to prevent impairments and secondary health conditions." (2016, p. 1).

The ISO 9999:2020-08 defines an assistive product as "product which optimizes a person's functioning and reduces disability". It is added that assistive products "include devices, instruments, equipment, and software" and that they "can be especially produced or generally available items".

Assistive products are sometimes also referred to as **aids** or **technical aids**.

The *Priority Assistive Products List* (APL) provides a collection of products that should be accessible in every country of the world (WHO, 2016). The top five product in the list are:

1. Alarm signallers with light/sound/vibration
2. Audioplayers with DAISY capability
3. Braille displays (note takers)
4. Braille writing equipment/braillers
5. Canes/sticks.

All in all, the list contains 50 products ranked as a priority in a multi-stage global survey.

1.3.2 The European Database EASTIN and Databases in the Different Countries

There is a European search engine on Assistive Technologies called **EASTIN - European Assistive Technology Information Network** (www.eastin.eu). It provides information on products in most languages of the European Union and also refers to national databases. You can search products by their commercial name, by the name of their manufacturer or by keywords, which match with an ISO classification code. In addition, AT manufacturing companies can be found. Finally, the EASTIN also provides articles with AT associated information like case studies or fact sheets.

The European database receives information from eight national databases:

- ATAust: Australia
- AZARIM: Israel
- DLF Data: United Kingdom

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- Vlibank: Belgium
- Siva: Italy
- Handicat: France
- Rehadat: Deutschland
- Hjælpemiddelbasen: Denmark

These national platforms provide specific knowledge on AT and information for potential users, informal caregivers and health professionals on assistive products available in the corresponding countries.

1.3.3 Exhibitions, Fairs and Living Labs

To find new innovations and individual solutions, there are exhibitions and fairs where companies show their products and services like the REHACARE (Düsseldorf) or the REHAB (Karlsruhe) in Germany, the SWISS Handicap (Lucerne) in Switzerland, or the ASSITIVE TECHNOLOGY (Tampere) in Finland.

In addition to exhibitions on general AT, there are also ones that focus on special impairments like the SightCity (Frankfurt, Germany), an exhibition demonstrating aids for blind and visually impaired people.

More and more universities and research centres are establishing so called “living labs”. These are smaller exhibitions where students, professionals and the public can watch and experience available products and new innovations on the field of AT.

The permanent exhibition “Hello Freedom! Together beyond barriers” is such a living lab. It is operated by Frankfurt UAS together with the Frankfurt Foundation for the Deaf and Hearing Impaired and the VdK Social Association Hesse-Thuringia. The objective is to inform on inclusion, participation and assistive technologies. In a 200sqm space, which is constructed like a flat, visitors can get to know different products for barrier-free living (also especially for hearing impaired people), get insights into technical solutions for ambient assisted living, telecare and telehealth, and meet emotional and social robotics.

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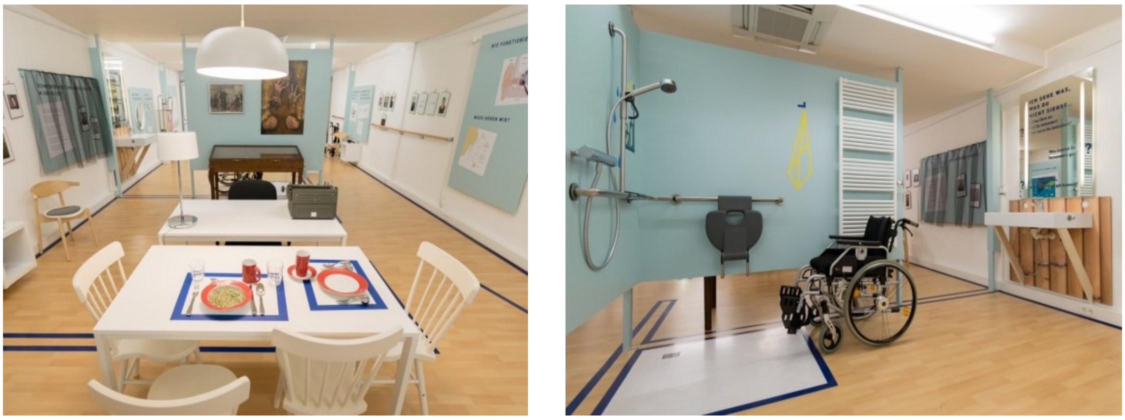

*Figure 3: Insights in the exhibition "Hello Freedom! Together beyond barriers,
(Pictures: K. Rupp, Frankfurt UAS)*

1.4: Different Types of Assistive Technologies

There are different types of distinctions for Assistive Technologies depending on how much technology they contain or on their function. Some of them are presented in this chapter.

1.4.1 From Low-tech to High-tech Assistive Technologies

Assistive Technologies can be described on a continuum from no or low-tech over med-tech to high tech devices (Chambers, 2020):

Low-tech Assistive Technology is the most easily accessible and usually the one with the lowest costs. It generally does not require special training. Examples are pencils grips or visual schedules. Because they do not need electricity, they can be used in most places.

Figure 4: Low-tech AT: Tableware set with high contrasts for people with vision impairments (Picture: J. Schneider, VdK Hessen-Thüringen e.V.) and slide board to facilitate a transfer (Picture: Fondazione Santa Lucia)

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Mid-tech AT has a power source but is often still available on reasonable prices and does not need extensive training to use. Examples for these are reading pens, single-phrase communication systems (Talkers) or audio books.

Figure 5: Mid-tech AT: Pen that reads out words saved on a sticker (Picture: A. Dürr), electronic bed that helps the user to get in and of the bed (Picture: K. Rupp, Frankfurt UAS)

High-tech AT is usually the most complex and also the most expensive option. It often has to be adapted and personalized and extensive training is needed to use it. Examples are Eye-gaze systems and text-to-speech software.

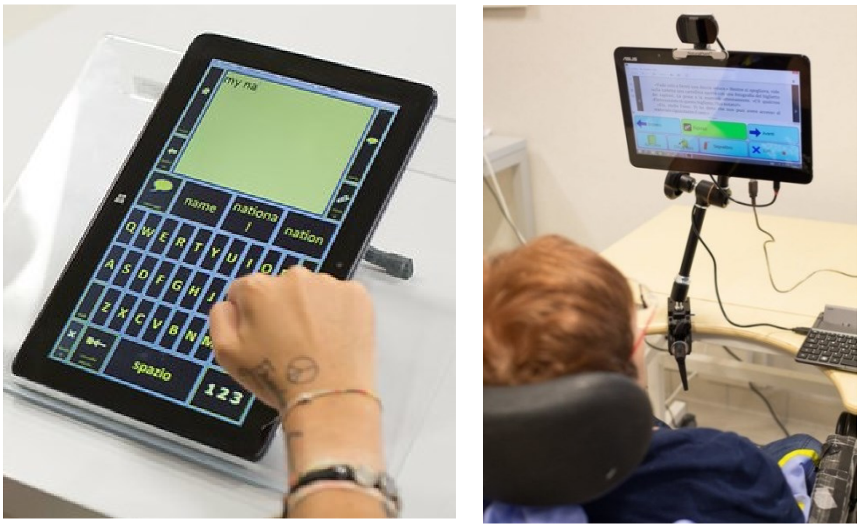

Figure 6: High-tech AT: Communicator with speech recognition and head tracking (Pictures: Fondazione Santa Lucia)

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The provision of a low-tech, mid-tech or high-tech device may depend on its accessibility, its price, its capacity to be personalized, the amount of training needed by the user and the caregivers and their attitudes toward the device, as well as the environment in which it should be used. For example, devices that have a battery need an electricity source and many intelligent software systems need access to the internet. If this cannot be provided the user will not be able to benefit from the product. The same problem appears if the device is technologically too complex and people perceive its usage as not simplifying their daily life. Then they might not use it either.

To obtain an impression, the following link provides an overview with examples of low-, mid- and high-tech AT: https://www.ctdinstitute.org/sites/default/files/file_attachments/AT-Solutions.pdf.

1.4.2 Further Classifications

For a more differentiated distinction Ritterfeld and Hastall (2017) propose a classification in types of function and modes of operation.

The type of function differentiates between prostheses, tools and environmental control:

- **Prostheses** refer to technologies which are close or connected to the body or are implanted (e.g., arm prosthesis, cochlea implant).
- **Tools** are close to the body, but they do not replace parts of the body. One example is the talker or a communication system in AAC.
- **Environmental control** involves indirect manipulation of the environment (e.g., via sensors, as in smart home applications or via voice control).

The authors further distinguish between the operation types **mechanical** (e.g., dental implant, wheelchair), **electrical** (e.g., stair lift) and **digital** (e.g., Talker, Smart Home).

For digital technologies the following characteristics are described (Ritterfeld & Hastall, 2017):

- **Sensor-based**: Sensor-based systems react to external stimuli such as light, heat or movement after being adapted (e.g., motion detector)
- **Interactive** systems provide for communication between user and system (e.g. a chat bot in an app for mental health).
- **Intelligent** systems use information from sensors as well as interactions with the user and thus develop further or adapt to the user (e.g., exercises in training software become more exhausting if the user gets better).

1.4.3 Assistive Products by Topic

Assistive devices can also be differentiated by the field in which they are used. The EASTIN provides nearly 70.000 products in twelve categories related to the ISO 9999:2016 Classifications:

ISO Code	Description

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04	ASSISTIVE PRODUCTS FOR MEASURING, SUPPORTING, TRAINING OR REPLACING BODY FUNCTIONS
05	ASSISTIVE PRODUCTS FOR EDUCATION AND FOR TRAINING IN SKILLS
06	ASSISTIVE PRODUCTS ATTACHED TO THE BODY FOR SUPPORTING NEUROMUSCULOSKELETAL OR MOVEMENT RELATED FUNCTIONS (ORTHOSES) AND REPLACING ANATOMICAL STRUCTURES (PROSTHESES)
09	ASSISTIVE PRODUCTS FOR SELF-CARE ACTIVITIES AND PARTICIPATION IN SELF CARE
12	ASSISTIVE PRODUCTS FOR ACTIVITIES AND PARTICIPATION RELATING TO PERSONAL MOBILITY AND TRANSPORTATION
15	ASSISTIVE PRODUCTS FOR DOMESTIC ACTIVITIES AND PARTICIPATION IN DOMESTIC LIFE
18	FURNISHINGS, FIXTURES AND OTHER ASSISTIVE PRODUCTS FOR SUPPORTING ACTIVITIES IN INDOOR AND OUTDOOR HUMAN-MADE ENVIRONMENTS
22	ASSISTIVE PRODUCTS FOR COMMUNICATION AND INFORMATION MANAGEMENT
24	ASSISTIVE PRODUCTS FOR CONTROLLING, CARRYING, MOVING AND HANDLING OBJECTS AND DEVICES
27	ASSISTIVE PRODUCTS FOR CONTROLLING, ADAPTING OR MEASURING ELEMENTS OF PHYSICAL ENVIRONMENTS
28	ASSISTIVE PRODUCTS FOR WORK ACTIVITIES AND PARTICIPATION IN EMPLOYMENT
30	ASSISTIVE PRODUCTS FOR RECREATION AND LEISURE

1.5: Assistive Technologies for Specific Impairments

In the following chapter, assistive devices for following five categories of impairments are presented: (1) blindness and vision impairments, (2) deafness and hearing impairment, (3) mobility loss, (4) speech, language and communication disorders as well as (5) intellectual disabilities and cognitive decline.

1.5.1 Blindness and Vision Impairment

More than 1 billion people suffer globally from vision impairments. Main causes are uncorrected refractive errors, cataract, age-related macular degeneration, glaucoma, diabetic retinopathy, corneal opacity, and trachoma. In high income countries diabetic retinopathy, glaucoma and age-related macular degeneration are more common in adults. For children, the main causes in middle-income countries are retinopathy and prematurity (WHO, 2020b). In 2014, 9.3% of the EU-27 citizens over 75 years reported severe difficulties in vision (Eurostat, 2020).

For vision impairments glasses and magnifiers are the most common assistive products. There are also electronic magnifiers as well as screen readers for computer work and television. Meanwhile many of those can be linked to common devices. Another solution is software which magnifies text material or transfers it into speech or braille. Today these assistive devices can be partially replaced by the functionalities of a smartphone such as zoom function, reading aloud and changing colour contrast. These functions can be further improved by special apps (Klein, 2020).

For everyday routine, a lot of "traditional" and digital devices exist. Examples are the following (Klein, 2020):

- A DAISY-Player (Digital Accessible Information System) allows getting access to literature

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or news. It plays audio data in individual speed, marks can be added and in some devices also self-generated speech notes are possible.

- Audio description is a standard in modern TVs and enables "watching" television through describing situations people would otherwise not understand without watching it.
- Speech output is available for clocks, kitchen equipment (level indicators signalling when a vessel is full), and health products (scales, blood pressure measuring…).
- Apps which scan bar codes can support shopping by telling the user information about the product.
- There are a range of products for people with visual impairments available such as large print like books or special designed card games.

Main assistive devices for blind people are the white stick or a guide dog. New products with the support of a laser or ultrasound application can identify barriers at the height of the upper body. Special navigation apps can help to find a way and also inform about important landmarks. Glasses with integrated cameras and speech-output dispose functionalities such as character recognition and reading aloud or face recognition and informing who is approaching, thus contributing to more autonomy (Klein, 2020).

1.5.2 Deafness and Hearing Loss

Around 466 million people worldwide, among those 34 million children are affected by hearing loss. Causes can be congenital or acquired by factors like infectious diseases, chronic ear infections, or expressive noise. In the age group of over 65, about one third of people are affected (WHO, 2020c). In the EU-27, 19.1% of the citizens aged 75 and older reported severe difficulties in hearing (Eurostat, 2020).

The main device for people with hearing loss is a hearing aid. It amplifies the acoustic signal and suppresses interfering sound. There are devices which are worn completely in or partly behind the ear; others are implants like for example the cochlea implant.

Amplification can be linked from external audio systems like a phone, the TV or a microphone directly to the hearing aid by an inductive coupler in the phone or a hearing loop. A special channel of the hearing aid has to be set to receive the audio input. The advantage is that interfering sound is suppressed. Hearing loops can be provided at service encounters, in churches, or meeting rooms. Another system to be used in public is the FM (Frequency Modulation) system. Here, a sender in a microphone is linked to a receiver that is usually worn around the neck. The receiver is directly linked to the hearing aid or the user wears a headphone which is linked to the receiver (Hearing Link, n.d.).

For deaf people or people with high hearing loss it is important to notice signals like phone calls, the doorbell ringing, or the alarm of a smoke detector. Therefore, it is recommended to use products which address the two-senses-principle. Here systems can be equipped (e.g., with flashing lights or vibration that are visible in the flat or linked to a device like a smartwatch or a smartphone). People communicating in sign language can use video phone devices, which transfer sign language as well as text. Today this is also possible with smart phones and messenger services (Klein, 2020).

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1.5.3 Mobility Impairment and Loss

Mobility impairments can be caused by many factors such as congenital disabilities, accidents, muscular diseases, stroke, or neurodegenerative diseases. Mobility loss occurs mainly in old age with 33.2% of the EU citizen over 75 years reporting severe difficulties in walking (AAATE & EASTIN, 2012).

Concerning mobility impairments, the WHO (2016) lists in its Priority Assistive Product List TOP 50 canes/sticks, chairs for shower/bath/toilet, club foot braces, crutches (axillary/elbow), fall detectors, hand rails/grab bars, orthoses (lower limb, spinal, upper limb), pressure reliefs cushions and mattresses, prostheses (lower limb), portable ramps, rollators, adjustable standing frames, therapeutic footwear, tricycles, walking frames/walkers, and different manual and electric wheelchairs. These are only a selection of the vast range of available products.

For people who need assistance, but are still able to walk, several types of walking-devices are available (e.g., walking-aids for one or both arms). Examples of aids for one arm are walking sticks and canes, as well as crutches. Walking sticks and canes are available with ergonomic handles, with three or more legs, foldable, with seat, with light, with umbrella function and much more (EASTIN, n.d.).

Examples of walking-aids for both arms are rollators, walking-frames, walking-bicycles, walking-chairs and walking tables (EASTIN, n.d.). They provide more stability for people with little strength and balance. Walking-frames can be used to train walking with a rollator, for mobilisation after events of stroke or surgeries, to stand up or for transfer. Walking-chairs provide the possibility to train walking in a sitting position, which prevents falls. Rollators help to move around safely indoors but also to go for a walk outside. Most of them provide space to store shopping or to sit down for a while.

If people are no longer able to walk and need a wheelchair, there are also different possibilities: Active and passive wheelchairs (which people push themselves or not), wheelchairs for inside and outside, electronic and non-electronic wheelchairs. For inside the house, there are also special bathing and toilet chairs (Gerlach, 2016).

Attention has to be paid to the control of a wheelchair (Gerlach, 2016). Handrim-drive wheelchairs can be single-side or bimanual, especially electric ones which can be moved with a joystick or other control-system such as head, mouth- or eye control.

Apart from systems to move around, immobile people also need other assistive products such as cushions or mattresses to prevent decubiti, positioning and transfer aids and lifters (Klein, 2020).

A new technology that is more and more entering the market are exoskeletons as well as intelligent prostheses and orthoses which support people to stand and walk or to retrain it.

1.5.4 Speech, Language and Communication Disorders

Speech, language and communication disorders can be congenital or acquired. If children do not acquire language, it may be due to genetic syndromes, autism, cerebral palsy, developmental disorders or hearing disorders.

Acquired speech, language and communication disorders are mainly caused by brain events such as traumatic brain injury, stroke, tumour or inflammatory processes or neurodegenerative or neuromuscular diseases.

Assistive Technology for people with limited speech is usually integrated in the concept of

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Augmentative and Alternative Communication (ACC). In this concept, there are methods in which either the own body or external aids are needed. Body-own methods are gestures, eye pointing, signing and vocalizations. External aids can be divided into electronic or non-electronic devices (Lüke, 2017).

Non-electronic devices are real objects, miniatures, pictures, sketches, symbols, or written language (Lüke, 2017). They usually involve pointing to something that stands for an activity, a need or a wish. Very common examples are communication books, which are usually individualized with special vocabulary (pictures or symbols) for the user. Individuals that are able to compose letters can use alphabet boards to express words or sentences.

Electronic devices can be divided into three levels (Lüke, 2017):

- Simple devices like switches or buttons that play a previously recorded text when pressed.
- Communication aids with a static display - They usually consist of symbols that play a specific text when pressed.
- Communication aids with a dynamic display – Here the vocabulary can consist of symbols or writing. Combination of symbols or words allows a wide range of vocabulary and sentence building, which are then spoken by a synthetic voice. There is also software which allows using a tablet-PC as communication aid.

Electronic communication devices have the advantage that they can also be controlled with special control systems like an eye tracker.

1.5.5 Intellectual Disabilities and Cognitive Decline

Intellectual disability (ID) is defined by the American Association on Intellectual and Developmental Disabilities (AAIDD) as "significant limitations in both intellectual functioning and in adaptive behaviour, which covers many everyday social and practical skills. This disability originates before the age of 22" (Schalock et al., 2021). People with intellectual disabilities may need support in the following main areas (Barr & Gates, 2019, p. 4):

- Conceptual: language, reading and writing, number (including understanding money and time)
- Practical: daily routine (washing, dressing, cooking,), staying safe, looking after health
- Social: getting on with people, managing social situations (including avoidance of being victimized, having a sense of self-worth)

Causes are often not clear but can be (genetic) syndromes like autism or down-syndrome, hypoxia, or developmental disorders due to prematurity.

Cognitive decline resulting in dementia comes along with the same symptoms, affecting "memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement" (WHO, 2020d). It usually occurs in old age, so the number of affected people in a society is growing when people get older.

As the symptoms of intellectual disability and cognitive decline are very different and often come along with comorbidities, it is difficult to name specific AT for this group as a whole. It is important to look at the specific needs and to find a product or service matching those needs. In a survey by Nijs and Maes (2019) professionals working with people with profound intellectual disabilities most commonly identified AT to support communication, relaxation and leisure. Tools to support

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participation in activities, to promote skill learning, to increase independence, to compensate for visual, auditory and/or motor disabilities, to support participation in society, to support daily care were also named by the participants.

For dementia, Gibson et al. (2014, p. 7) identified five categories of AT products and services used by people with dementia:

- Time/place orientation: clocks, signage, reactive and adaptive lighting, navigation aids
- Prompts and reminders: medication dispensers, memory aids
- Communication aids: intercoms, telephones, telecare alert equipment
- Tools and aids: dementia friendly furniture, aids for activities of daily living (ADLs)
- Alerts and alarms: alerts for ADLs, scheduling and reminder alarms

There were also categories of tools used 'with' and 'on' people with dementia. The former were communications aids, tools for play and enjoyment and for reminiscence, the latter telecare systems, GPS and locations alarms, and safety and security tools (Gibson et al., 2014).

1.6: Provision of Assistive Products

Scope and execution of financial support for the provision of assistive products differ between the European countries. Therefore, general provision models as well as examples of countries in the EU are described below.

1.6.1 General Provision Models

In a position paper, AAATE & EASTIN (2012) describe three main delivery models:

- **The medical model:** Any AT devices are prescribed by a professional (usually a physician, but sometimes also an occupational therapist, nurse etc.). Public provision is usually regulated by a list of products or product specifications and prices that are reimbursed.
- **The social model:** Within this model the focus is on the solution, not on the device. A budget for the solution is decided, then the choice of the device is relatively free.
- **The consumer model:** The device is directly chosen and paid for by the user. Financial help, information and professional support service are provided.

In practice, boundaries between these models are not that strict, there are mixed forms that tend towards one or more of the models.

The HEART study (European Commission & Technology Initiative for Disabled and Elderly people, 1995) identified seven steps in a service delivery process that are similar throughout the European countries:

1. Initiative (the first contact with the service delivery system)
2. Assessment (evaluation of needs)
3. Selection of the assistive solution (defining the individual AT programme)

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4. Selection of the equipment (choosing the specific equipment within the AT programme)
5. Authorisation (obtaining funding)
6. Implementation (delivering the equipment to the user, fitting and training)
7. Management and Follow up (maintenance and periodic verification)

In the following, the procedures in several European countries are presented:

1.6.2 Germany

Assistive products that are assigned to an individual person and that are part of a national device list ("Hilfsmittelverzeichnis") are paid for by the individual's health or care insurance, if a medical doctor prescribes it. Products in this national device list are categorized in:

- so-called "Hilfsmittel" (AT Products) and are subject to the Social Security Statute Book V Statutory Health Insurance (§33) (SGB V) and
- nursing care aids ("Pflegehilfsmittel") which are subject to the Social Security Statute Book XI Statutory Nursing Care Insurance (§40) which also deals with the financing of accessible conversion.

Currently, more than 32,500 devices are listed. Devices from this registered list (like a wheelchair or a communication aid) have to be prescribed by a physician. The person, who has to be insured with the Statutory Health Insurance, has to contribute with a co-payment of 10% (max. 10 Euro for AT with regard to the Statutory Nursing Care Insurance and max. 25 Euro for nursing care aids with regard to the Statutory Nursing Care Insurance). Disposable products up to 40 Euro per month are reimbursed by the Statutory Nursing Care Insurance. The Statutory Nursing Care Insurance provides also a financial contribution up to €4,000 for home modification (Klein, 2020).

Since 2020, digital health apps can also be prescribed by a physician and are paid by the patient´s Statutory Health Insurance. It is required that the app is acknowledged as medical product which has to be guaranteed by a CE sign (Weckerling, 2019) as well as a certification procedure with appropriate evidence.

Currently, the national device list is updated on a regular basis and it can be observed that a lot of new products are being taken up. Also, a variety of robotic systems are listed such as exoskeletons, robotic arms, robotic feeding devices, mobility support etc.

Physicians can also prescribe AT which is not listed in the national device list.

1.6.3 Italy

The National Health System delivers aids and prostheses listed in the Nomenclatore Tariffario, the official aids and prostheses nomenclator. The aids and prostheses nomenclator is a document published and periodically updated by the Ministry of Health which defines which aids and prostheses can be funded by the National Health System and their supplier modalities. The latest version of the nomenclator was published on January 2017.

Each Italian region, taking in to account the maximum rates for prosthetic assistance services set by the Ministry of Health, in agreement with the Ministry of Economy and Finance, defines a

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maximum rate for each element in the nomenclator. The user will pay any difference between the price defined by the region and the price of the device provided.

The Nomenclator is organized as following:

- List 1: tailored prostheses and orthoses designed by a qualified professional, the add-ons and the extraordinary maintenance, repair, customization or replacement of components of each prosthesis or orthosis
- List 2A: technological aids produced in series which must be applied by the qualified health professional to guarantee the correct and safe use by the patient
- List 2B: technological aids produced in series, ready to use, which do not require the intervention of the health professional to guarantee the correct and safe use by the patient

The aids to support communication, interaction with the environment and access digital technologies are part of List 2B.

The Nomenclator does not contain specific products, but it provides a description and a code for each type of aids (e.g., "dynamic communicator"), specific products can be prescribed by indicating the nomenclator code corresponding to their operation and function.

The procedure for aids and prostheses delivery is divided into the following phases: definition of the individual rehabilitation plan, prescription, authorization, delivery, testing and follow-up.

The individual rehabilitation plan is defined by the specialist doctor in collaboration with the multidisciplinary team according to the patient's needs. The prescription is a task of the specialist doctor of the national health system who must have specific skills in the prescription of prostheses, orthoses and technological aids. The local health authority authorizes the aids delivery whether the patient is entitled to it, there is an individual rehabilitation plan, and the prescription is complete.

The specialist doctor, who did the prescription and who is responsible of the individual rehabilitation plan, is responsible for the testing of the device. The test consists of a clinical-functional evaluation aimed at ascertaining the correspondence of the device delivered to the one prescribed and its effectiveness for the individual rehabilitation plan. The testing procedure is conducted by the specialist doctor with the multidisciplinary team and, if needed, by other technicians with specific professional skills in the field of communication and information aids (ICT) (Gazzetta Ufficiale della repubblica italiana, 2017).

1.7: Ambient / Active Assisted Living (AAL)

The acronym AAL stands for "Ambient Assisted Living" and subsumes intelligent technologies that support independent living especially in old age or with disabilities, in order to enhance autonomy, safety, to prevent social isolation and to support caregivers. In 2014, the EU AAL programme changed the term into "Active Assisted Living" (Calvaresi, 2017). Today both terms are used

The areas of AAL application range from pure convenience functions such as automatically switching off kitchen appliances or lighting, to everyday support that enables people to live independently in their own homes, monitor vital functions or automatically notify emergency services in an emergency (Wirtschaftslexikon Gabler, 2018).

Devices like wearables that detect vital signs or sensors that recognize falls and send an alarm are essential AAL tools. They are connected to a platform, for example, on the user's or caregiver's smartphone or in a nursing or physician's information system.

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AAL is often used as an umbrella term which covers mainly eHealth and Smart Home Technologies and related services (Andelfinger, 2016). Since 2008 the AAL Programme as a funding programme of the European Commission and European countries has been established, which "aims to create better quality of life for older people and to strengthen industrial opportunities in the field of healthy ageing technology and innovation" (AAL Europe, n.d.). To date more than 220 projects have been funded (Farla et al., 2020).

In 2020, results of these projects were evaluated by Farla et al. with a response rate of 85 (43%) projects. Of these:

- 23 solutions were developed which help people feel safe by preventing physical and emotional harm (e.g., by fall detectors, creation of care networks). Over 31,500 people are reported to use these solutions. Example: https://hallozorg.nl/
- 20 solutions for participations in social life were developed including devices that simplify contact to friends and family and platforms were older people can meet. Close to 29,000 people are using them. Example: https://www.emma-hilft.com/
- 12 solutions for an active lifestyle (e.g. serious games) with 13,000 users. Example: https://www.seniorweb.nl/
- 13 solutions for supporting informal carers with 25,500 end-users among them 5,000 informal carers.
- 6 solutions for the early detection of risks with 21,000 end-users. Example: https://cogvis.ai/cogvis-en/
- 13 solutions for supporting formal carers like information sharing platforms or remote monitoring with 26,000 end-users, among those 5,500 formal carers.

Overall, 24 projects (12% of all funded projects) were identified to have launched 31 AAL solutions/components on the market.

As barriers and challenges to enter the market the following aspects were named:

- Issues in finance and commercialisation
- Market fragmentation
- Policy and regulatory issues
- User acceptance issues (Farla et al., 2020)

1.8: Accessibility

According to the Oxford Dictionary the adjective "accessible" has several meanings in everyday life, like something is able to be reached, to be easily obtained or used or something is easily understood or appreciated. In addition, "accessible" is explained as able to be reached, entered or used by people who have a disability.

Erlandson (2008, p. 18) defines accessible design as "the design of entities that satisfy specific legal mandates, guidelines, or code requirements with the intent of providing accessibility to the entities for individuals with disabilities.", which refers to laws and provisions as basis of the design approach and of accessibility standards.

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The **United Nations Convention on the Rights of Persons with Disabilities** defines in Article 9, Nr.1 accessibility as “To enable persons with disabilities to live independently and participate fully in all aspects of life (…) [and] to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communication, including information and communication technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas.”

Figure 7: Accessibility for blind people: Information in Braille (Picture: J. Schneider, VdK Hessen- Thüringen e.V.)

After the EU and most of its Member States ratified the UN Convention on the Rights of Persons with Disability, the EU developed the European Disability Strategy 2010 – 2020. Part of that strategy is the **European Accessibility Act**, a directive which has to be converted into national law by the member states by June, 28th 2022 and applied from July 28th, 2025.

With the European Accessibility Act the EU aims to improve the market for accessible products and services for persons with a disability. Products like computers, smart phones and TV equipment as well as services like bus and rail ticketing, banking services and e-commerce have to be accessible for people with disabilities then (European Commission, n.d).

For digital technology, including websites, software, electronic devices, and mobile apps the **European Standard for Digital Accessibility EN 301 549** was published in 2014. The EU members are asked to integrate the directive into law by 2018 (European Telecommunications Standards Institute, ETSI, 2018).

By 2021, all public websites and all mobile apps in the public sector have to contain this standard that since has been updated via the **Web Content Accessibility Guidelines (WCAG) 2.1** (World Wide Web Consortium, 2018).

These guidelines offer an overview of barriers that exits for people with disabilities and provide accommodation for:

- blindness and low vision
- deafness and hearing loss
- limited movement
- speech disabilities

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- photosensitivity
- learning disabilities and cognitive limitations

The guidelines are translated into several languages.

Another concept that is important to provide accessibility to web contents is **Easy Language**. It helps people with low literacy levels to understand contents better. Examples of recommendations are collected by Yalon-Chamonitz (2009):

- Keep sentences short (no more than 15 or 20 words)
- If you have to use a difficult word, explain what it means
- Use full words and avoid abbreviations
- Use large print, a clear typeface, plenty of spacing
- Avoid jargon
- Use bullet points or fact boxes
- Use active rather than passive verbs
- Use simple punctuation
- Do not hyphenate words at the end of a line

 (Disability Rights Commission (DRC), 2006; Mencap, 2000; Frehoff et al., 1998; as cited in: Yalon-Chamonitz, 2009, p. 387)

There are international guidelines for accessibility in broad areas of life. They are defined by the International Organization for Standardization (ISO). You can find them on: https://www.iso.org/home.html.

Examples for ISO Standards towards accessibility are:

- ISO 9999:2020 Assistive products – Classification and terminology
- ISO 21542:2011 Building construction - Accessibility and usability of the built environment
- ISO 9241-20:2008 Ergonomics of human-system interaction - Part 20: Accessibility guidelines for information/ communication technology (ICT) equipment and services
- ISO/TC 173 Assistive Products for persons with a disability
- ISO 16201:2006 Technical aids for persons with disability - Environmental control systems for daily living
- ISO/ IEC 40500:2012 Information Technology - W3CWeb Content Accessibility Guidelines (WCAG) 2.0
- ISO/ IEC 24786:2009 Information technology - User interfaces - Accessible user interface for accessible settings
- ISO 17069:2020 Accessible Design – Consideration and assistive products for accessible meeting

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- ISO 17966:2016 Assistive products for personal hygiene that support users – Requirements and test methods
- ISO/TR 22411:2008 Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities

1.9: Universal Design

Article 2 of the UN **Disability Equality Convention** refers to the importance of "universal design" of products, environments, programmes and services so that they can be used by all people without adaptation or specialized design.

For major principles of Universal Design were identified by Ron Mace (Null, 2013):

- Supportive: provides a necessary aid to function (additional lights for working spaces)
- Adaptable: serves users whose needs change over time (ergonomic chair)
- Accessible: without barriers (wider doors that work for wheelchairs as well as furniture transports)
- Safe: promotes health and wellbeing and is preventive (contrasting colours for changing floor levels)

In 1997, those principles of Universal Design were extended to seven principles by the Centre for Universal Design at the North Carolina State University (Null, 2013):

1. Equitable use: no disadvantage for any group of users (no step entries)
2. Flexibility in use: accommodates a wide range of individual preferences and abilities (right- and left-handed access)
3. Simple, intuitive use: easy to understand (blue for cold, red for hot)
4. Perceptible information: communicates necessary information (smoke detector with sound and light alarms)
5. Tolerance for error: minimizes hazards and accidents (induction cooktop, which is not hot to touch)
6. Low physical effort: can be used with a minimum of fatigue (remote window controls)
7. Size and space for approach and use: regardless of user's size, posture, or mobility (knee space at a sink or cooktop)

These design principles intend "to simplify life for everyone by making the built environment, products, and communications equally accessible, usable, and understandable at little or no extra cost." (Null, 2013, S. 4).

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Figure 8: Kitchen with sufficient space for wheelchair users under cooktop. Exhibition “Hello Freedom! Together beyond barriers”, Frankfurt (Picture: K. Rupp, Frankfurt UAS)

In the **UN Convention on the Rights of Persons with Disabilities** the States Parties committed:

- “To undertake or promote research and development of universally designed goods, services, equipment and facilities, (…), which should require the minimum possible adaptation and the least cost to meet the specific needs of a person with disabilities, to promote their availability and use, and to promote universal design in the development of standards and guidelines.” (Article 4f)
- “To promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost.” (Article 9h)

1.10: Digital Health

Vollmar et al. (2017) recognises the terms “digital health” or “digital health applications” as the most comprehensive and inclusive, as all information and communication technologies from the health sector are included. For example, e-health, mobile health, telemedicine, big data or health apps. This definition illustrates the complexity of the concept. It is not limited to services or applications, but contains many other concepts:

1.10.1 E-Health and M-Health

The term stands for the use of information and communication technologies combined with electronic devices in medical care and health-related services (according to WHO in Albrecht, 2016). Characteristic are information technology-supported applications in which information can be exchanged and processed electronically, thus supporting the treatment and care processes of patients (Klein & Oswald, 2020).

M-Health is a component of e-health and primarily includes the use of wireless, i.e., mobile devices (such as mobile phones, tablets or wearables) in prevention and health care with the aim of patient-

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centred care (Klein & Oswald, 2020).

1.10.2 Health Apps

These apps run on smartphones, smartwatches, tablets and PCs. They can also be linked to a variety of sensor-based and information technology supporting devices, e.g., to measure vital signs, but also to game consoles and virtual or augmented reality glasses. The apps can collect large amounts of data. This data is also called **Big Data**. **Artificial intelligence (AI)** is often used to analyse Big Data with the help of algorithms (Klein & Oswald, 2020).

There is a growing market for health apps: In August 2020 111,440 health and fitness apps and 50,930 medical apps could be downloaded on Google Play (iTunes/Apple app store not available). The majority were developed for prevention (e.g., increasing movement, relaxation and improving nutrition) and self-management, with fewer being developed for therapy, diagnosis and in the management of illness (HealthOn Statistiken, 2021).

1.10.3 Telemedicine, Tele monitoring, Telecare

Telemedicine, as well as tele monitoring and telecare are about health care services being provided by health care providers outside traditional locations (General practitioner's office, Hospitals) by means of information and communication technologies. These terms emphasize that the respective services are provided from a distance by means of new technologies. With the help of these technologies, better care can be provided in rural areas, e.g., via video-based remote consultation hours or decentralised monitoring of patients with chronic diseases (Klein & Oswald, 2020).

Many digital health concepts or applications are related to AAL. They include a technology and service provision with specific organizational requirements.

1.11: Connection between the Different Concepts

Differentiation between the concepts which are connected to the field of Assistive Technology is sometimes not obvious. The following figure aims to give an overview about how the different terms interact:

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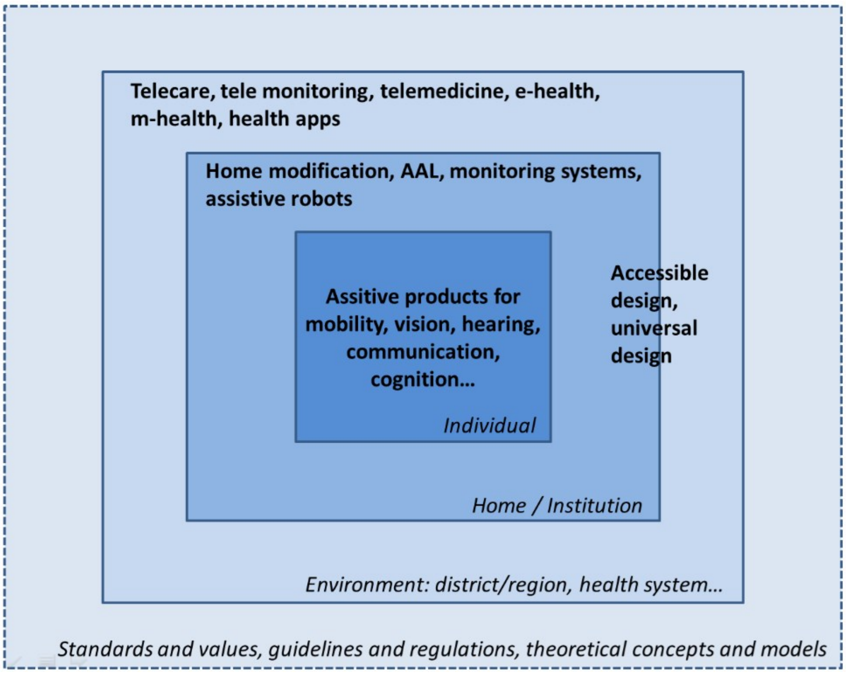

Figure 9: AT and connected terms (own figure)

1.12: Acceptance of Assistive Technologies

Acceptance of Assistive Technologies is crucial for utilizing the full potential. Sometimes it is not easy to reach acceptance for a product or a service because there are many external and internal factors of influence. They can be obvious or subconscious. In the following sections, connections between those factors and user behaviour are described with the help of acceptance models.

1.12.1 The Technology Acceptance Model (TAM)

Technology Acceptance Models aim to predict behavioural intention to use technology. The most prominent and most used model (Claßen, 2013) is the **Technology Acceptance Model** (TAM) by Davis (1989).

In this model, it is assumed that intention is the best predictor for actual use. Intention is influenced by two attitudes:

- Perceived usefulness, which is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320)
- Perceived ease of use which is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320)

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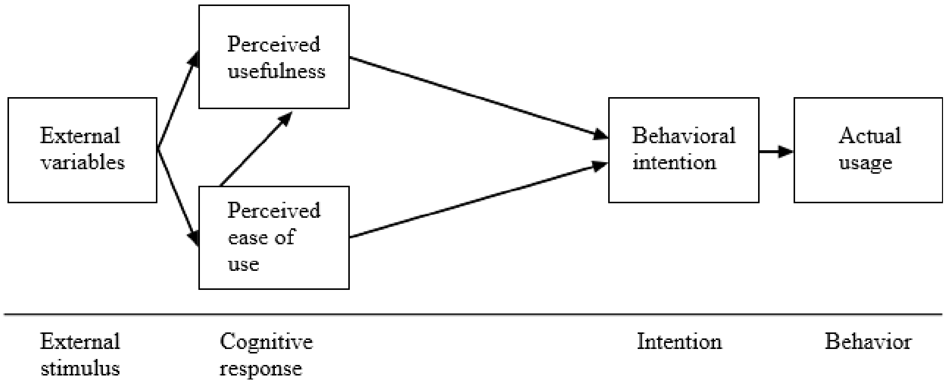

Figure 10: Technology Acceptance Model (TAM) (Davis & Venkatesh, 1996, p. 20)

This model was adapted several times and other factors were added that influence perceived usefulness and intention and therefore behaviour (Venkatesh & Davis, 2000):

- Subjective norms: People chose the behaviour of which they think it is expected of them
- Image: The influence on the social status in which the usage results
- Job relevance: Degree in which a system is applicable to a person's job
- Output quality: How well the system performs
- Result demonstrability: If the covariation between usage and positive results is discernible
- Experience: The intention may change over a certain time of usage
- Voluntariness: There may be a difference between mandatory and voluntary usage settings

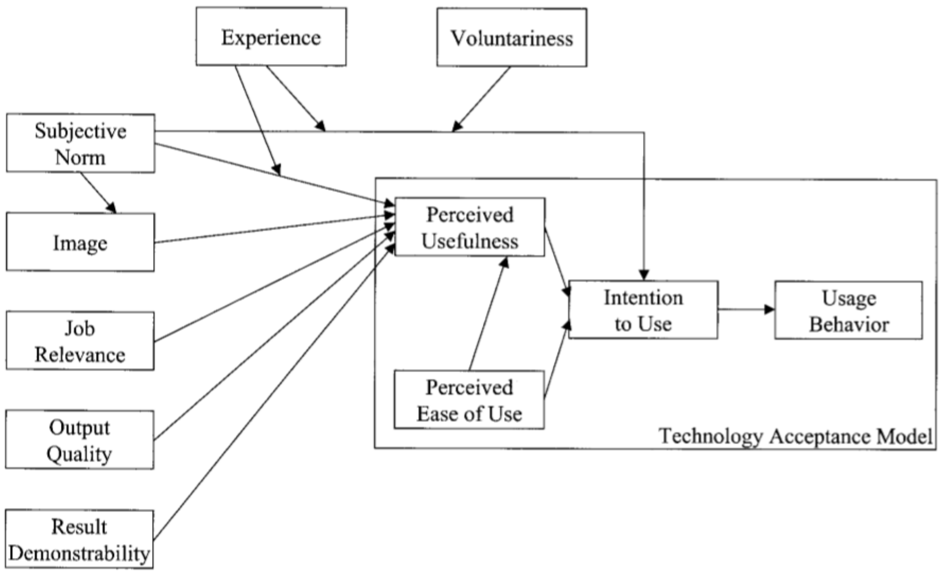

Figure 11: TAM2 (Venkatesh and Davis, 2000, p. 188)

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1.12.2 The Unified Theory of Acceptance and Use of Technology (UTAUT)

In a summary of multiple acceptance models Venkatesh et al. (2003) developed the UTAUT. In this model behavioural intention and usage behaviour are determined by four direct factors:

- Performance expectancy: “the degree to which an individual believes that using the system will help him or her to attain gains in job” (p. 447)
- Effort expectancy: “the degree of ease associated with the use of the system.” (p. 450)
- Social influence: “the degree to which an individual perceives that important others believe he or she should use the new system.” (p. 451)
- Facilitating conditions: “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.” (p. 453)

In addition, the influence of four key moderators is described: Gender, age, experience and voluntariness.

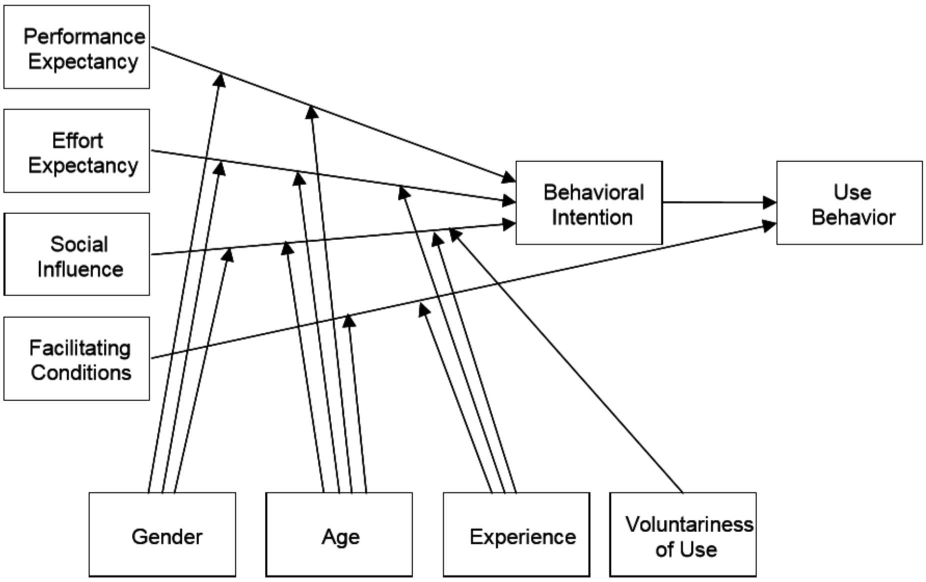

Figure 12: The UTAUT (Venkatesh et al., 2003, p. 447)

1.12.3 The Matching Person & Technology (MPT) Assessment Process

To identify the most appropriate technology for a person the Matching Person & Technology (MPT) Model and assessment instruments were developed by Scherer (1998, p. 1). In an assessment process

- the user’s needs and goals,
- potential barriers to optimal technology use,
- areas to target for training for optimal use,
- and the type of additional support that may enhance use

are identified. The MPT forms are also administered post AT acquisition to assess changes.

In the MPT process, user and provider are working together in six steps. In the third step, the

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Assistive Technology Device Predisposition Assessment (ATD PA) is administered. The ATD PA:

- "inquires into consumers' subjective satisfaction with current achievements in a variety of functional areas (9 items),
- asks consumers to prioritize aspects of their lives where the most improvement is desired (12 items)
- profiles consumers' psychosocial characteristics (33 items),
- and asks for consumers' views of twelve aspects of using a particular type of assistive device" (Scherer & Craddock, 2002, p. 2).

The MPT progress can be carried out in various settings and with different AT users.

1.13. Ethical Aspects

Implementation and usage of Assistive Technology can raise ethical questions. AT providers, prescribers, and caregivers have to considerate the pros and cons and advise the potential users to the best of their abilities. Many aspects have to be taken in account here. The chapter presents ethical principles, possible issues and an instrument to provide a framework for facilitating decisions.

1.13.1 Ethical Principles

Five ethical principles are described by Kitchner (2000). Cook (2009) applied these principles for Assistive Technology development and application, Panico et al. (2020) for AAL technologies:

- Autonomy (freedom of choice and action) – For AAL technologies this means that the technology must not interfere with the will of the person it is caring for. People should maintain responsibility for their decisions.
- Beneficence (ensuring that actions benefit others) – Applications should be only on the benefit of the individual.
- Non-maleficence (not causing harm) – This also includes psychological or emotional harm, (e.g., when people are forced to use applications, they do not want or if they perceive themselves as disabled by using them). But non-maleficence can also mean not withholding an assistive product.
- Fidelity (faithful, trustworthy, honest and loyal behaviour) – People must be able to trust the device and have confidence in the human-machine-interaction.
- Justice (fairness in individual, interpersonal, organizational and societal contexts) – This may concern the question who is provided with which devices and services in a society.

Cook also addresses the principles of utility, which can be seen as the requirement that a device provides useful functions for the user (Panico et al., 2020) and independence, which means maximum participation in society (Cook, 2009).

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1.13.2 Ethical Issues in Health Care Technologies

Relevant critical ethical and social issues of health care technologies are summarized by Stahl and Coeckelbergh (2016):

1. Implications for society and health care
    - Replacement and its implication for labor
    - Replacement and its implications for the quality of care: de-humanization and "cold" care (less human contact)
2. Implications of technology taking over task from humans
    - Autonomy (How autonomous should the technology operate?)
    - Role and tasks (Technology and human: who leads, who assists?)
    - Moral agency (Ethical reflection in critical situations cannot be secured by technology)
    - Responsibility (Who is responsible, especially for autonomous systems?)
    - Deception (Is a potential deception e.g., through robots as social companions justifiable?)
    - Trust (To which amount can we trust the technology?)
3. Issues concerning human users
    - Privacy and data protection
    - Safety and avoidance of harm

In summary, ethical aspects do not only concern the individual who is provided with AT but also informal and formal caregivers and other professionals and service providers, as well as society in general.

1.13.3 The MEESTAR - A Model for the Ethical Evaluation of Socio-Technical Arrangements

MEESTAR (Manzeschke et al., 2015) describes a **M**odel for the **E**thical **E**valuation of **S**ocio-**T**echnical **AR**rangements and provides a framework to discuss and assess assistive technologies with respect to different ethical values and different perspectives (individual, organisational and social). It also covers practical, organisational issues such as obtaining informed consent.

- The model contains seven ethical values (Examples for ethical related questions)
    - Care (Changes in the relationship?)
    - Autonomy (How can people be assisted in their autonomy?)
    - Safety (Any conflicts between privacy and safety or autonomy and safety?)
    - Justice (Who gets access? How is the technology financed?)
    - Privacy (Protection of cognitive impaired people?)
    - Participation (What participation for older people?)
    - Self-conception (Social constraints arising from the images of technically assisted age and aging?)

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- Three perspectives have to be considered:
  - Individual level
  - Organisational level
  - Societal level
- Stages to assess the technology:
  - Stage I: The use is harmless
  - Stage II: There is an ethical sensitivity
  - Stage III: The use is extremely sensitive and requires action
  - Stage IV: The use has to be rejected from an ethical point of view

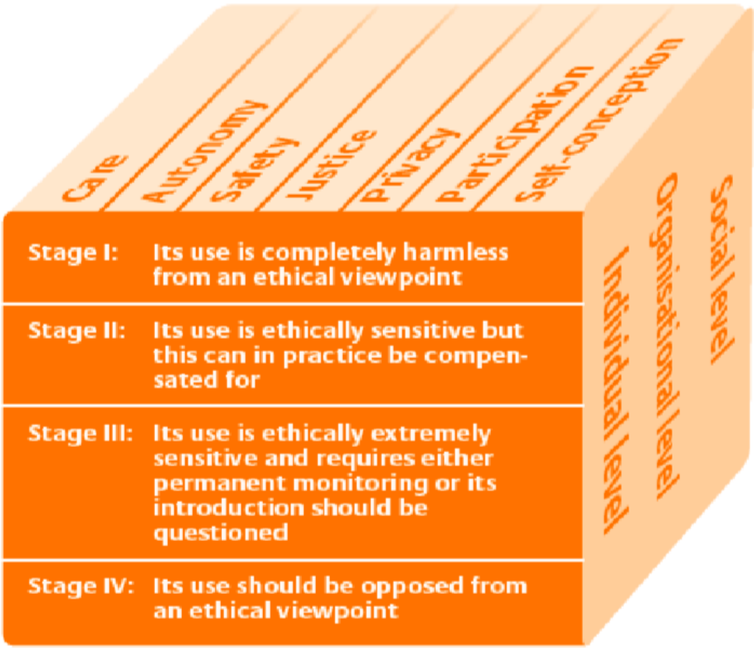

Figure 13: The MEESTAR (based on Manzeschke et al., 2015)

Example: Ethical Issues in EU-Project I-SUPPORTED BATH ROBOTS[1]

A robot was designed to help people with functional declines to take a shower on their own. Interviews and focus groups were held to find out user's opinions towards the technology. Results indicate different perspectives of primary and secondary users:

- Primary users stress that they want to wash themselves independently and have choices according to their lifestyle preferences
- Secondary users see the benefit – and stress their contribution to the care process (promoting remaining resources, monitoring skin and health status, relationship work)

Conflicting dimensions: autonomy and care, privacy and safety, justice and safety, choice and

[1] HORIZON 2020 PHC-19-2014; Research & Innovation Actions; Grant agreement n°: 643666

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justice, human-robot-interaction and care.

1.14: Data Protection in the EU

In the EU, data protection is regulated in the **General Data Protection Regulation (GDPR) 2016/679**. It was passed in 2016 and has to be adopted in member countries since 2018.

In this regulation, i.e., in the Article 8(1) of the **Charter of Fundamental Rights of the European Union (the 'Charter')** and Article 16(1) of the **Treaty on the Functioning of the European Union (TFEU),** the protection of personal data is described as a fundamental right.

For personal data processing, the following principles are specified:

1. Lawfulness, fairness and transparency in relation to the data subject
2. Purpose limitation: Data has to be collected for a specified, explicit and legitimate purpose
3. Data minimisation: collected data has to be adequate, relevant and limited to what is necessary
4. Accuracy: Data has to be kept up to date; inaccurate data has to be erased
5. Storage limitation: Data has to be kept in a way that identification is possible no longer than necessary
6. Integrity and confidentiality: Data must be protected with appropriate technical or organisational measures against unauthorised or unlawful processing, and accidental loss, destruction or damage.

In terms of data processing with Assistive Technology, the following articles of the regulation are relevant:

- Article 6 states when data processing is lawful, this is the case (e.g., if the data subject has given a consent).
- Special categories of personal data such as health data or biometric data are protected under extra conditions in Article 9.
- The rights of the data subject are stated in Articles 12-23.
- Articles 24-43 are concerning the controller and processor.

1.15: Usability and Participatory Design

Assistive products and technical aids as well as apps and internet platforms have to conform to legal, normative and also accessibility standards if companies want to provide them. But usage and acceptance factors like usability or user-centred design also play an important role. Today, caregivers often do not feel involved in the development of digital technologies which could facilitate their working life (Daum, 2017). Technologies are mostly developed in labs where engineers work on technical challenges, but the solution does not always fit the caregiver's culture and values (Merda et al., 2017).

The principle is the same for users with functional, cognitive or mental disabilities. To make sure

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that Assistive Technologies fit for them and that they like their usage, engineers have to involve user-centred factors like simple menu structures, easily understandable terms or displays with good contrast and adjustable volume in the process of development and design.

The scope should not be what is technically feasible but what meets the users' (professionals' and clients') requirements (Kuhn et al., 2019). Therefore, **Participatory Design** is considered to be the State-of-the-Art in technical design (Klein & Oswald, 2020). It aims to make users participate in the design process so that the result fits their needs.

In a systematic review Merkel and Kucharski (2019) reported studies that involved users in various stages of the innovation process (Framework from Shah et al., 2009):

1. Idea generalization and conceptualization
2. Device (re)design and prototype development
3. Prototype testing
4. Device deployment in the market

The authors state that many studies only focus on one phase and not on the whole process (mostly focusing on phases 2 and 3) and that the participating users are often not equal partners who influence decisions. They recommend evaluating participatory design approaches for positive outcomes. This may lead to an increased willingness to use a device but may also result in the involved users feeling adequately integrated in the process.

Another approach of involving broad networks of the general public in scientific research is called **Citizen Science**. It describes networks of collaborating people who provide data for researchers to develop new research questions and so also get a better understanding of scientific work. These collaborations lead to more democratic research (Socientize, 2015).

1.16: Current and Future Developments

With a trend towards a more inclusive society the living environment and mainstream products are accessible and usable for a larger amount of people with disabilities.

This can be observed especially in ICT products (AAATE & EASTIN, 2012). Applications like speech recognition and read aloud functions help people with vision impairments, auto correction supports people with difficulties in writing. For a lot of situations, a smartphone or a tablet can replace a specific assistive product (Klein, 2020).

Apps for Augmentative and Alternative Communication (ACC) can be used via a tablet; a specific talker is not needed then. Video chats can help people with hearing impairments to communicate in sign language and messenger services can be used communicate in written language for people who do not understand sign language. In many cases, one device can even replace several specific aids. An additional advantage is that commercial products do not stigmatize their users in the same way as specific assistive products sometimes do (Kreidenweis, 2018).

The application of sensors will simplify life more and more, especially when linked to a smart home environment. Invisible applications can regulate home environments independently or by speech control, which is especially helpful for immobile people.

Individualization is very important for many assistive products in terms of operation (handles, switches) or fit (prostheses, hearing aids). Another trend in AT can be printing individual parts or

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whole devices with a 3D printer (Klein, 2020). This could offer new possibilities of individualization.

Topic 2: Smart Home

2.1: Introduction

"Smart Homes can prove cost-effective in aiding the elderly and disabled to remain in the home for longer in a non-obtrusive way. This can allow greater independence and quality of life while reducing the chance of social-isolation" (Bennet et al., 2017, p. 2).

Smart home is a considerably old term, first introduced in 1984. The first ideas of augmenting the home with technology are even older, having been established in the 1970s with the development of the first microprocessors (Bennet et al., 2017).

Smart home technologies cover a wide range of different services. Generally speaking, smart home products offer comfort, security or health-related solutions in the home environment. In the following section the main focus will be on healthcare-related smart home technologies. Since other categories of smart home, such as general domestic appliances, also offer assistance that can be helpful for elderly persons and people with disabilities, these will also be covered.

Due to its fast-evolving nature, smart home technologies are difficult to consistently define, but they promise considerable advantages over their non-smart counterparts. In the following section, the term "smart home" and the structure of the technology will be explained. Examples of smart home use for supporting people with disabilities or functional decline will be provided, alongside the benefits and concerns of smart home technologies.

2.2: Definitions

The terms "Smart Home" and the connected phenomenon "Internet of Things" are described below:

2.2.1 Smart Home

Various definitions exist for the term "smart home", some focusing on technical components, others on functionalities or services. The following two definitions give a broad overview:

Aldrich (2003) described a smart home as "a residence equipped with computing and information technology, which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through the management of technology within the home and connections to the world beyond" (Aldrich 2003, p. 17).

According to Brendel (2019) the term smart home refers to a home that is equipped with information and sensor technology and is networked both internally and externally. Related terms are "smart living" and "intelligent home". The aim of smart home is to increase the quality of life

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and living, of security and of energy efficiency, which has both economic and ecological implications. Brendel also emphasises the strong relationship to the concept of "the Internet of Things" (IoT).

Depending on the implied definition of smart home, certain devices or functions may be included or excluded. For example, telecare can be included or excluded depending on the given definition (e.g., Tang & Venables, 2000; Valero, 2007).

2.2.2 Internet of Things

The phenomena Internet of Things (IoT) describes the concept that things like sensors and mobile phones "interact with each other and cooperate with their neighbours to reach common goals" (Atzori et al., 2010, p. 2787). This offers huge potential e.g., for the health care and smart environment domain.

According to Atzori et al. (2010) benefits from IoT technologies are:

- Tracking: identification of a moving person or object
- Identification and authentication: to reduce incidents through mismatching and for security procedures
- Data collection: to reduce processing time, for process automation, for automated care and processing auditing
- Sensing: Sensor devices provide real time information, e.g., on people's health and thus allow patient centred care

In a smart home environment, sensors and actuators can help to adapt room heating and lightening according to the weather or the daytime or to avoid accidents with monitoring and alarm systems (Atzori et al., 2010).

2.3: Building Automation

It is possible to use certain smart home applications or to organize the whole flat or house as a smart home. This is mainly possible in new buildings because it already has to be taken into account when planning and equipping the building. In the following, the modes of operation of building automation are presented in a simplified manner.

Figure 14 shows the different levels of building automation. The basis is formed by the electrical installations which are controlled to carry out specific applications in the home. They are responsible for the distribution of electricity, water, gas, telephone and internet. In a smart home, they are controlled with the help of a so called 'BUS systems' that interlinks the components (Aschendorf, 2014).

The building automation then contains sensors and actuators. Sensors collect data by measuring specific conditions, e.g., the temperature. Via the BUS system this data is sent to the actuators, where various processes and functions are carried out, and e.g., the heating is turned down

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(Aschendorf, 2014). This data can also be directly sent from the control and regulation level if the function is programmed (Wosnitza & Hilgers, 2012).

The components on the control and regulation level transfer data to the BUS System. They are responsible for the time and presence control and for the analysis of temperature or the lighting in a room (Aschendorf, 2014). The regulation works via a comparison of actual and target values. The target values have been set before the actual values are recorded by the sensors (Wisser, 2018).

On the top is the management level. Here all the functions can be visualized and manually controlled, and as well as faults are reported. Operating elements can be displays installed in the building, remote control or PCs, notebooks, tablets or smart phones. With a mobile device, functions can be controlled via an app from anywhere, including outside the home (Aschendorf, 2014).

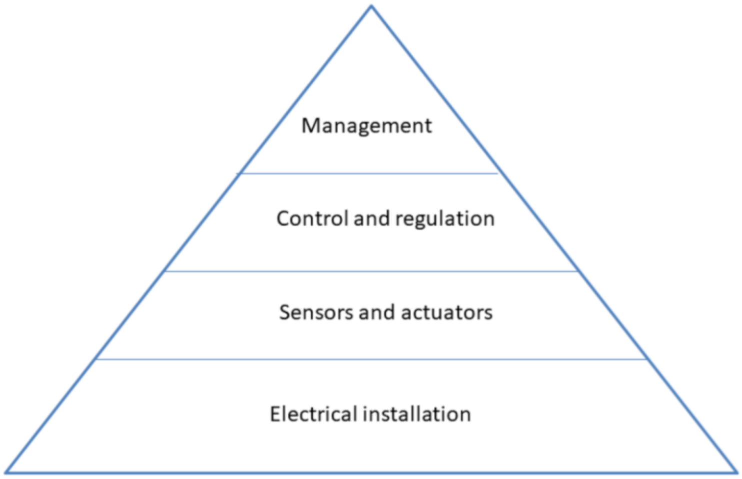

Figure 14: The different levels of building automation (based on Wisser, 2018)

2.4: Levels of “Smartness”

The transition from an “ordinary” to a “smart home” is described in 5 levels by Sovacool and Furszyfer Del Rio (2020):

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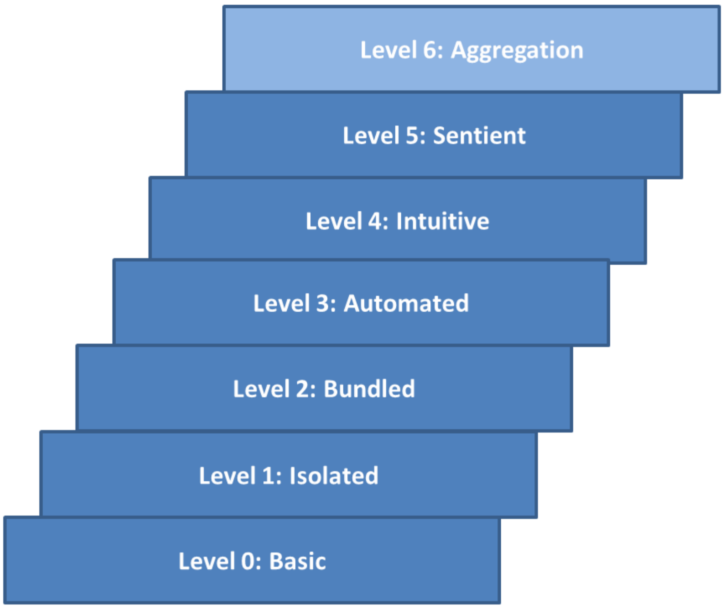

Figure 15: Smart Home - Levels of smartness (adopted from Sovacool & Furszyfer Del Rio, 2020, p. 7)

On the basic level, the home is completely analogue without any smart technology. On the first level, some isolated smart technologies, such as a smart TV, are implemented which then become bundled and programmable on the second level (e.g., the TV is coupled with a laptop).

On the 3rd level, greater automation occurs, the systems begin to interconnect and anticipate certain needs. On this level, appliances are turned on shortly before the user returns home. At level 4, systems react to sensors, begin to learn and to adapt their service provision on context. For example, the lights turn off if the sun is coming out. At level 5, the home automatically will meet and anticipates all household needs.

A 6^{th} level is discussed where intuitive or sentient smart homes become interconnected in smart neighborhoods, communities, and cities (Sovacool & Furszyfer Del Rio, 2020).

2.5: Smart Devices

Smart devices, also called smart home products or smart technology, are everyday objects upgraded with information technology that receive added value through sensor-supported information processing and communication (Lackes & Siepermann, 2018). Main characteristic of smart technology is to appropriately react to information collected from the surroundings (Chan et al., 2008).

The number of devices on the market is huge. Schiefer (2015, p. 116) grouped them in 15 categories:

- *Controlling Systems*: Products like base stations, systems that only control the Smart Home (tablet/smartphone and apps)

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- *Security Systems*: Lock systems, surveillance cameras and similar devices
- *Safety Systems*: Products to detect and avoid threats to life or physical condition, e.g., detection of gas or water leaks and smoke detectors.
- *eHealth Systems*: Devices for medical inspection and medical assistance
- *Measurement and Sensors*: Water meter, electric meter etc.
- *Heating, Ventilation and Air-conditioning*: Systems to regulate room temperature and air ventilation like thermostats, climate control units or ventilator
- *Light and Shadow*: Devices emitting or preventing light, like lamps, awning and roller blind
- *Kitchen Devices*: Products like cooker, refrigerator and coffee maker
- *Water Systems*: Tap, bath tube and toilet as well as lawn sprinkler
- *Cleaning Systems*: Systems to clean up, like washer, dishwasher, but also robots for vacuum-cleaning
- *e-Pet Systems*: This category consists of every device around pets or animals. This can be a necklace for locating, a robot to stroke or an automated feeding system.
- *Entertainment*: Audio systems, television, gaming consoles, toy robots
- *Pieces of Furniture*: Seating and sleeping accommodation like massage giving mattresses, as well as desks, closets
- *Agility Devices*: Devices for transporting persons, like cars, bicycle and bicycle gadgets
- *Others*

2.6: Smart Home Technology and AAL

A concept that is strongly related to smart home technologies is "Ambient/Active Assisted Living" (AAL, see chapter 1.7). The term AAL is defined as concepts, products and services combining new technologies and the social environment and improving these with the aim of enhancing the quality of life for people at all stages of life (DIN SPEC 91280, p. 5). The focus is on helping people to remain independent in their homes in old age or with disabilities. This can also be with the help of smart home technologies such as smart doorbells, fall sensors and intelligent refrigerators. So AAL can be described as field of application for smart home technologies (Wisser, 2018).

In general, smart home technologies focus on:

- Entertainment & lifestyle
- Work and communication (e.g., Home office)
- Sustainable housekeeping trough energy-saving heating and light control
- Safe living (door and window surveillance, holiday management)
- Health and nutrition (BITKOM, 2011).

But the devices are also often useful for people in old age or with disabilities, such as smart speakers being useful to compensate restricted mobility. So, the transitions between smart home technologies and AAL applications become more and more fluid in the health and social care sector (Choi et al., 2019; Sanchez-Comas et al., 2020). According to Eberhard (2020) the smart home

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approach is based on connected components, where else for AAL applications also individual smart products can be helpful.

2.7: Smart Devices in the AAL Field

Smart devices can support people in old age or with disabilities living in their home environment and relieve caregivers through systems that raise people's autonomy and warn of danger (Wisser, 2018). These are especially systems for environmental control and healthcare specific devices.

2.7.1 Smart Devices for Environmental Control

This category includes smart devices that enable the user to control certain aspects of their home environment. Examples are presented for specific disabilities or functional declines:

- **Immobility**: Automatic door-opening, sensor-based products for heating, shutter opening, and lighting, smart speakers or remote control to avoid walking to switch on and off things, electronic beds or armchairs, fall detectors
- **Vision impairment**: Voice command to control everyday-actions (e.g., switching of the cooker, or switching on the washing machine), get information or send messages; sensor-based products for orientation in outside spaces
- **Hearing loss**: Vibration alarm from the door or the smoke detector to a wearable device
- **Cognition**: Drug reminder systems, smart home sensors that recognize deviations and initiate an alarm call, house emergency system, automatic cooker switch-off

Functions which are very useful for people with various declines are voice control and voice output. Several commercial providers offer special "smart speakers" like the Amazon Echo, the Google Home or the Apple HomePod. These devices provide the possibility to control interconnected smart home technology by voice (Noda, 2017). Some functions are provided by the speaker itself and only require an internet connection. Apart from playing music, a smart speaker can e. g. set alarms or reminders, manage calendars or shopping lists, as well as search the web or order items (Bentley et al., 2018; Noda, 2017).

While many functions help to improve quality of life, some functions also directly apply to improve health conditions like asking for the nearest on-duty pharmacy, making an emergency call or using a reminder for medication.

Particularly for people with restricted mobility or restricted vision the voice control can contribute to a barrier-free environment, making living at home more autonomous and reducing the burden of demanding help from others (Noda, 2017).

Disadvantages of smart speakers can be data security risks, see chapter 2.11.

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2.7.2 Healthcare-specific Smart Devices

Smart home devices of this category are developed in order to provide solutions for specialised health conditions. The two main applications are the management of chronic diseases and independent living in old age (BITKOM, 2011).

Management of chronic diseases

Persons with chronic diseases can use devices to measure their vital signs (e.g., pulse rate, blood pressure, respiratory rate) or other parameters (e.g., weight, blood sugar) with smart devices (e.g., wearable, smart scales, smart blood glucose measure) which send the data to a platform, (e.g., on a smartphone). People can then exchange these data with their physician or a medical/nursing service, so that the parameters can be monitored. In case of emergency, saved contacts like a family member or a medical service can be called automatically (BITKOM, 2011).

Independent living in old age

Smart home emergency systems can detect emergencies, as well as deviations from daily routine which indicate potential danger, especially with regard to people living alone. This goal is realised by measuring actions within determined periods of time and areas of the home (Eberhardt, 2020).

Home emergency systems mainly contain an emergency button with a design often similar to a wristwatch, necklace or an electronic car key. They can be used for years without recharging. Additionally, sensors can be installed in the flat in order to measure/track daily home routines.

For example, accidents at home are often related to slipping, tripping or falling. In some cases, these accidents lead to situations, in which people (for instance elderly persons) lie on the ground for long periods of time unnoticed by others, being unable to call for help themselves due to injury. In situations like these, users of home emergency systems can push the emergency button to initiate an emergency call or the system itself registers an anomaly in the daily routine and informs the according services or relatives (Eberhardt, 2020).

By providing permanently active safety support, the home emergency system disburdens the user of the fear of being unperceived whenever accidents occur and therefore provide support for autonomous living in old age, with disabilities or with diseases. By doing so, the emergency system also provides relieve for relatives and healthcare professionals that no longer fear unnoticed accidents.

2.7.3 Generations of Smart Devices: Example Telecare

Smart home technologies became more innovative over time. A good example of this progression is in telecare (Klein et al., 2013):

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1. Generation
Basic personal alarm, the alarm has to be triggered and a telecare center is alerted; call operator and service user can talk to each other and decide on appropriate action

2. Generation
Passive, automatic alarm, e.g. heat sensors, water detectors trigger the alarm

3. Generation
Based on user profiles alarms are triggered by specified deviations

4. Generation
Web-based communication platforms integrate different technological systems and devices as well as different services

5. Generation
Integration of robotic devices in the process e.g. telepresence robots

Figure 16: Generations of telecare (Klein et al., 2013)

1. Generation: Basic social alarm

The devices provide more safety for older persons because they can raise an alert to a telecare centre in the case of an emergency. The call operator in the telecare centre and the service user can talk to each other and decide on appropriate action.

- The alarm has to be triggered actively
- Base station in private home connected to the telephone network
- Base station has hands-free system with loudspeaker and microphone
- Service user must carry a small transmitter with push button (radio finger)
    - Bracelet, watch or chain
    - Allows an alert to be triggered from any location at home

2. Generation: Passive and automatic alarm

Sensors "recognize" an emergency (e.g., smoke) and trigger an alarm to the telecare centre. No action is needed by the older person.

- Alarms are triggered when specific thresholds are met and depending on the sensor's type that can be later translated accordingly to a specific event.

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- Some of these sensors originate from security technologies (e.g., heat sensors, water or smoke detectors)
- Sensors used for health-related topics such as fall prevention (e.g., accelerometer, locations sensors, fall mats or bracelets)
    - Epilepsy sensors can be integrated into the bed and trigger an alarm during an epileptic attack

3. Generation: Devices are able to monitor the service user by predefined profiles

The third generation comprises sensors allowing a more complex "intelligent" approach for an alarm situation. Alerts can be triggered according to the profile of the user.

- Movement or magnetic contact detectors are installed in the apartment, which can measure activity events.
    - Activity is automatically registered when a person passes by. Only when the user's daily activities differ from the defined settings, an alarm is triggered
    - The same applies to a contact detector at the refrigerator or the bathroom door
- New range of devices due to Internet of Things (IoT) allow more possibilities to define emergencies (e.g., Wearable device with IMU (Inertial Measurement Unit) and a button with WiFi and BLE (Bluetooth Low Energy) connectivity)

4. Generation: Web-based communication platforms

A web-based platform allows personal alarms, web pages and apps, smart home technologies and other technologies to be linked. Different technological systems and devices as well as different services can be integrated.

5. Generation: Integration of robotic devices

Robotic devices can be integrated in the telecare services.

- Already commercially available products are telepresence robots for the integration in the telecare process

2.7.4 Control of Smart Home Devices

The operation of smart home environments can be difficult for inexperienced users (Eberhard, 2020):

- Simple switches can not only switch something on and off or move it up and down, but may trigger something different with a single click than with a double or triple click. A short press may mean something different than a long press.
- Symbols on switches have to be understood and small font sizes be read

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- On tablets or monitors, colour contrasts and font sizes cannot always be changed which may be difficult with vision decline
- The use of a touchpad can be difficult with dry fingers, which often pose a problem to elderly
- Control via voice command may be difficult for people with dialect or accent as well as with speech or language disorders

Some of these difficulties may not only occur with the actual users/residents, but also with staff involved in the health and social care sector (Eberhardt, 2020).

2.8: Acquisition of Smart Home Technologies

If a client is interested in obtaining smart home technologies, there are two ways of financing. If the device is classified as an assistive medical device, it can be funded partly or fully by insurance or state programmes (Peckham, 2018). Otherwise, the customer can purchase the device privately.

Funded by insurance or state programmes

The financing of assistive devices differs widely within the states of the European Union. See chapter 1.6 for examples, how the provision in Germany and Italy is regulated.

Privately financed

If not classified as a medical device, users can privately acquire smart home devices or functions via two routes. Either by purchasing a package from a smart home service provider, or by selecting a “do-it-yourself” option (OECD, 2018).

Packages of smart home service providers (also called multiple system operators) contain assortments of complementary devices (e.g., smart lock + doorbell). Along with providing smart home packages those companies also undertake the installation and continuous support. Consumers pay fully or partly for the acquirement of the packages and/or a subscription fee over the contract duration (OECD, 2018).

Otherwise, consumers can choose the “do-it-yourself” option. Then, they select a smart home technology from a manufacturer or retailer and install it on their own. Similar to the first option, in some cases a subscription fee has to be paid in order to receive associated functions (OECD, 2018). Aside from that, there are instances in which options are mixed (e.g., a package subscription and payment of related devices) (OECD, 2018).

Neither one of these options can be considered appropriate without taking into account the unique situation. As many smart home devices are cost-intensive, a subscription may enable an early acquirement but commit the client to a specific company. This can prove to be a disadvantage in some cases, when a better device of another company appears on the market. Also due to the rapid development of smart home technology, devices and services may become outdated relatively fast.

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On this basis, purchasing of a device may turn out to be a money saver, or it could be a bad investment.

2.9: Benefits

Smart home technologies don't require active actions from their users (Eberhardt, 2020), and therefore seamlessly integrate into everyday routines. If intendedly working, devices like fall sensors only emerge within the user's perception when needed. This can result in an efficient home care environment that may not be perceived as controlling.

Main benefits for clients in health care are the specific functions of the devices, care accessibility and availability, as well as users' safety, leading to higher quality health care (Marikyan et al., 2019). Because of their connectivity, smart home technologies can increase reliability of their services, thus enriching user experience. By connecting the user to the outside world smart home may also improve socialization and support of overcoming the feeling of isolation (Marikyan et al., 2019).

Other benefits of smart home technologies are health monitoring and disease management. For example, smart home devices can be used for monitoring the cognitive state of elderly people, enabling an alert when health inconsistencies occur (Czaja, 2016). This is especially useful for elderly people, people with disabilities or people with chronic diseases. Within these populations, smart home technologies contribute to a better health assessment. They improve quality and quantity of information that can be utilized by a clinician (Chan et al., 2009). "Measures of physiological signs and behavioural patterns can be translated into accurate predictors of health risk, even at an early stage, and can be combined with alarm-triggering systems as a technical platform to initiate appropriate action" (Chan et al., 2009, p. 93).

With regards to possible users, many target groups can benefit from smart home technologies. Chan et al. (2009) see the following groups as relevant:

- People living alone who are unable to seek help in emergencies (unconsciousness, falls, strokes, myocardial infarction, etc.)
- Elderly or disabled people who suffer from cognitive (Alzheimer disease, dementia, etc.) and/or physical (visual, hearing, mobility, speech, etc.) impairment
- People who need help in daily life to perform personal care activities (eating, toileting, getting dressed, bathing, etc.) and instrumental activities (cooking healthy meals, dealing with medication, and doing laundry)
- Informal (family, friends, neighbor people) or formal (care provider) caregivers for the elderly or the handicapped
- People living in rural and remote communities or in urban communities with inadequate health service provision
- People who suffer from chronic disease, and who need continuous monitoring (diabetes, cancer, cardiovascular disease, asthma, COPD, etc.)
- People involved in telehealth care undertaking health care at a distance or telemedicine, with physicians practicing 'virtual visits' (Chan et al. 2009, p. 93).

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2.10: Statistics on Smart Home

According to latest estimations, smart home revenue in Europe is predicted to increase sharply over the next few years. It is suggested that revenues could more than quadruplicate between 2017 and 2025 (from 9.7 million to 39.8 million), which indicates a high growth of the user rate, as well as growing interest in smart home technology (Statista, 2020).

Regarding the different sectors, no change of order is expected. While every sector will increase their revenue, 'Smart Appliances', 'Control and Connectivity' and 'Security' will keep on forming an integral part of smart home revenue. Creating about two thirds of smart home revenue, 'Home Entertainment', 'Energy Management', and 'Comfort and Lighting' together make up the remaining third of smart home revenue (Statista, 2020).

The *Smart Home Consumer Survey 2018* conducted by Deloitte provides an additional overview in regard to smart home usage for Germany. In this study, Deloitte analyzed the results of an online survey conducted with 2000 German smart home users between the age of 19 and 75 (Deloitte, 2018).

The results from the study about interest in smart home solutions (Figure 17) reflect that, even though smart home products can be of good use in healthcare, the actual users tend to be more interested in products that provide solutions for home comfort or security, rather than healthcare (Deloitte, 2018).

In any of these categories, at least 20% of the participants were planning to buy an associated product in the next year (Deloitte, 2018). Even if these buying intentions may not be realized, it reveals a strong urge to owning smart home products.

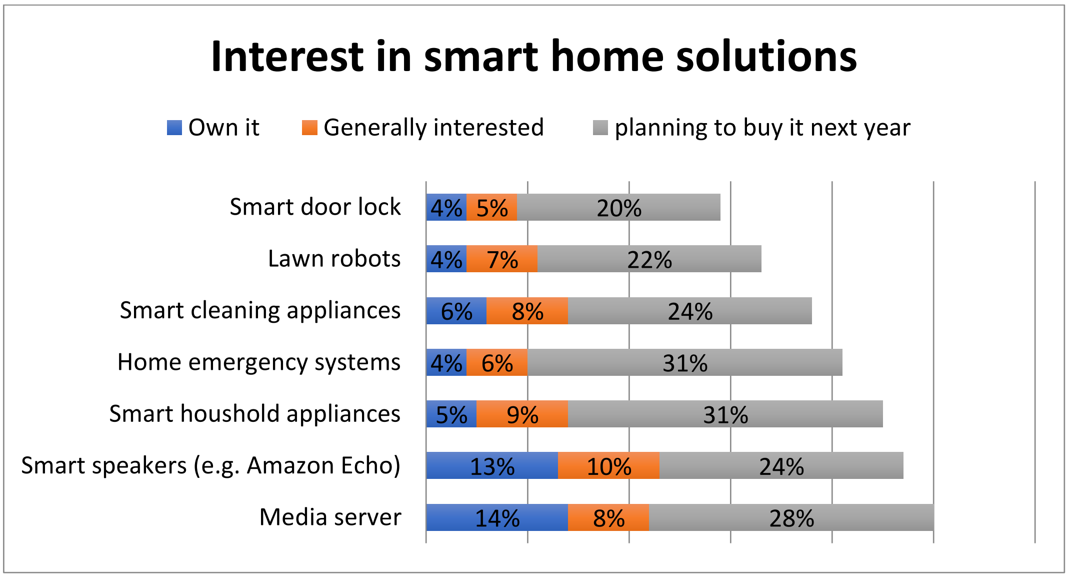

Figure 17: Interest in smart home solutions (adopted from Deloitte, 2018)

Around 20% of the respondents between age 19 and age 54 use smart home products (Figure 18). Within the two older age groups the usage decreases (Deloitte, 2018). In this sample only 14% of

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people between 55-54 and 9% of people over 65 years use smart home devices. Despite the promising benefits of smart home technology for the 65+ group, smart home devices are not yet accordingly used by them. This might be the cause for the underrepresentation of healthcare appliances.

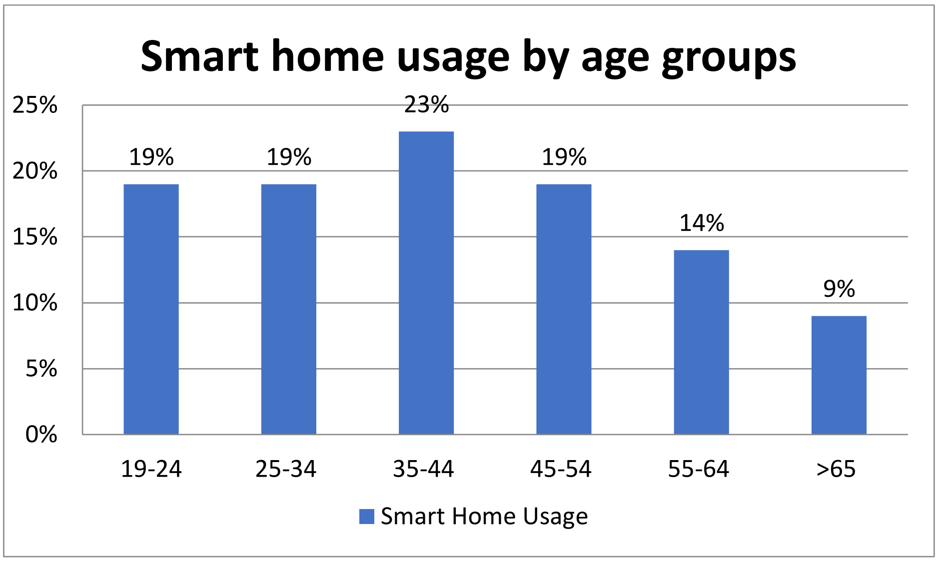

Figure 18: Smart home usage by age groups (adopted from Deloitte, 2018)

There is a strong relation between net income (per month) and possession of smart home devises (Deloitte, 2018). This may imply that potential users in lower income groups consider smart home devices as being too expensive relative to their efficiency (see figure 19).

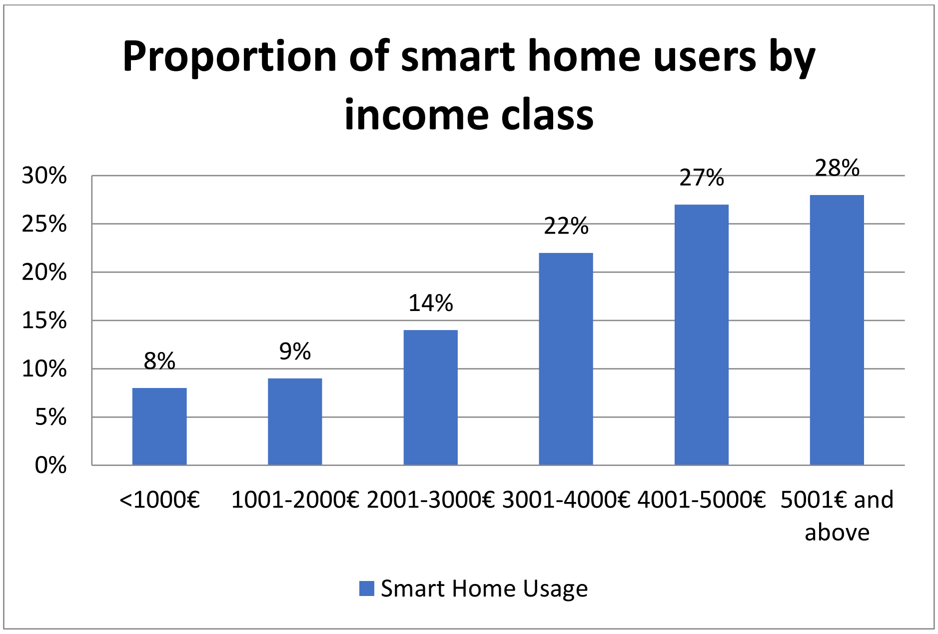

Figure 19: Smart home consumer survey (adopted from Deloitte, 2018)

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While it is expected that the cost of smart home devices will decrease over time, this issue should not be ignored with regard to healthcare. After all, high costs could further increase inequality and prevent equal access to smart home if the costs are not adequately covered by the state or insurance.

Taking into account the results of the Deloitte study, health-related smart home devices so far have a relatively low impact on the target groups compared to their theoretical potential, especially among older people.

2.11: Ethical & Legal Concerns

In their integrative review Chung et al. (2016) discuss ethical concerns of smart home technologies for older adults. The aspects are not focused on health care services but related to all target groups of smart home usage. Chung et al. outline seven key dimensions:

1. Privacy
2. Informed consent
3. Autonomy
4. Obstructiveness
5. Equal access
6. Reduction in human contact
7. Usability (Chung et al., 2016, p. 155)

2.11.1 Privacy

By capturing data in the home environment, smart home technologies promise to improve functional health, quality of life, security and safety. But by doing so, smart home is collecting private data, which in turn creates a risk of violating the user's privacy in two ways:

- By sharing users' information without permission
- By acquiring users' information against their will (Chung et al., 2001; Leino-Kilpi et al., 2001)

2.11.2 Informed Consent

Generally, the transmission of data itself can be precisely monitored. Additionally, the authorization of data access can be determined. It is important that monitored users understand the functionality, trust in smart home appliances and know who is included in the processes (informed family members and services providers) in order to give their necessary consent (informed consent) (Eberhardt, 2020). Only with understanding of the functionalities and processes, are users in a position where they can make informed decisions (Chung et al., 2016).

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2.11.3 Autonomy

Even though smart home technologies are supposed to expand the autonomy of the user, there is paradoxically, a risk that it will be restricted. The passive nature of their monitoring functions may discourage users from actively participating in the operation and management of the system. Chung et al. (2016) also discuss the fear of becoming too dependent on smart home technologies.

2.11.4 Obstructiveness

Since the perception of obtrusiveness is a subjective matter and smart home technologies invade the privacy of the users at home, possible concerns about obtrusiveness must be taken into account, e. g. disturbing noise, physical strain, malfunction or inaccurate measurement (Chung et al., 2016).

2.11.5 Equal Access

Referring to the digital divide[2] Chung et al. (2016) stress the importance of equal access. For example, older adults living in a rural or urban under-resourced area are more likely to be disadvantaged in terms of technology use.

Furthermore, costs of smart home technologies represent a barrier. Installation costs and subscription fees for ongoing monthly services (such as connection to a Web portal) may not be paid by insurance companies and thus represent a barrier for those who cannot afford the expenditures themselves (Chung et al., 2016).

2.11.6 Reduction in Human Contact

Another concern is that smart home technologies could replace face-to-face contact with digital alternatives (e. g. virtual visits or remote monitoring). With the aim of reducing costs, the use of digital communication devices could lead to a reduction or loss of human contact, thus discouraging users from human touch and therapeutic interactions with caregivers or clinicians (Chung et al., 2016).

2.11.7 Usability

According to Chung et al. (2016) the usability of smart home technologies has so far not been fully addressed. Smart home designs often do not meet the needs of older adults and do not take into consideration age-related constraints and lack of experience. For example, even switching on and off devices can be problematic for people with loss of vision or mobility limitations.

[2] "[G]ap in access to and usage of information and communication technologies between those who have access to the technology and those who do not, because of age, income, education, community type, disability, or other factors" (Chung et al. 2016, p. 174)

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2.11.8 Legal Concerns

Legal concerns of smart home technology rise from its relatively young nature. Laws and practices have yet not been introduced sufficiently. It is especially necessary to establish new laws that cover conflicts of users and service providers concerning received smart home products (Marikyan et al., 2019).

With regard to the concerns caused by the relative novelty of smart home technologies, the OECD (Organization for Economic Co-operation and Development) outlines the following risks:

- Hybrid nature of products: Products that combine hardware that consumers own and software used under license may change traditional notions of ownership.
- Lack of interoperability: The incompatibility of connected devices and systems, whether they result from market conditions, design differences or contractual restrictions, may create consumer lock-in.
- Ubiquitous data collection: The collection of vast, untargeted data from smart devices can create privacy risks.
- Security vulnerabilities: The connected nature of the products and the need for updating can create additional security vulnerabilities that can be exploited by malicious actors and have physical as well as virtual consequences.
- Aftermarket support requirements: The lack of aftermarket support can challenge the usability, safety and security of a smart home device or ecosystem.
- Complex supply chains: While not unique to smart homes, the multiple entities involved in developing, manufacturing and maintaining smart home devices and products can have implications for consumers’ ability to obtain redress or determine liability if something goes wrong (OECD 2018, p. 16).

2.12: Perspectives

This chapter gave an insight into smart home technologies and their benefits and concerns for healthcare-related purposes. As shown here, smart home technologies can be applied to various contexts and are already used in many households. Especially the functionalities ‘environmental control’ and ‘emergency monitoring’ are useful for people in old age and with disabilities. Tracking health data like vital signs or other specific parameters can help people with chronic diseases to better manage their wellbeing. The impact on social health and social interaction has to be further investigated.

As with every data driven technology, smart home technology is most effective when being provided with as much user information as possible. This raises concerns about how much information can and should be revealed. On one hand, smart home technologies can improve healthcare support at home. On the other hand, the home is a private environment that is that is particularly sensitive to monitoring and control. As with all digital technologies, it is important that the user understands the functionalities and has the opportunity to make an informed decision.

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Topic 3: Robotics in the Health and Social Care System

3.1: Introduction

As the proportion of older residents in European countries is growing and life expectancy is getting higher (Eurostat, 2020), many countries face the challenge to find sufficient professional caregivers. Especially in countries with a skills shortage in the care sector, the gap between individuals that need and those who provide care or rehabilitation is widening.

In industrial settings, robotic systems already support workers in routine processes or with physically strenuous activities. In the social and health care sector, those developments enter the field with some delay because activities with humans are not standardized and many ethical, data safety and security aspects have to be taken into account. But in some fields, robotic systems have entered the market or are in development. In the following chapters, application for robotics in the health and social sector are described as well as developments and product groups. In a further step, acceptance of robotic systems is analysed and ethical issues are considered. Finally, a look is taken at the difficulties in the dissemination of robotic systems and an outlook is given on aspects that could spread the use of robotics in the health and social sector.

3.2: Definitions

For the field of robotic systems in the health and social care system, some definitions are essential. Therefore, in the following section, some terms are defined according to the ISO 13482 norm (ISO 13484:2014, p. 3):

A **robot** is an "actuated mechanism programmable in two or more axes with a degree of autonomy moving within its environment, to perform intended tasks", whereby **autonomy** means "the ability to perform intended tasks based on a current state and sensing, without human intervention".

A **service robot** is a "robot that performs useful tasks for humans or equipment excluding industrial automation application".

A **robotic device** is an "actuated mechanism fulfilling the characteristics of an industrial robot or a service robot, but lacking either the number of programmable axes or the degree of autonomy".

A **mobile robot** is a "robot able to travel under its own control".

3.3: Fields of Application for Robotics in the Health and Social Care Sector

To provide a classification for robotic systems in the health and social care sector Klein et al. (2018) propose to structure them according to their application in:

- Robotics for rehabilitation
- Robotics to support caregivers and other staff

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- Robotics for support at home

Becker et al. (2013) also structure robotic systems in three categories:

- Training devices and aids for movement performance, mobility and independence - they train and support movements and activities.
- Telepresence and assistive robotics replace the presence of a person (e.g., caregiver, therapist) or support the user in activities
- Social-interactive robots act with people as a companion

The authors of both publications add that these classifications are not final and some systems also correspond to more than one category. Medical robots for surgery are not part of the classifications and are not included in this unit because it is not relevant to most of the staff in the social and health care sector.

The following figure shows an overview about robotic systems according to the classification of Klein et al. (2018). The individual areas are described thereafter.

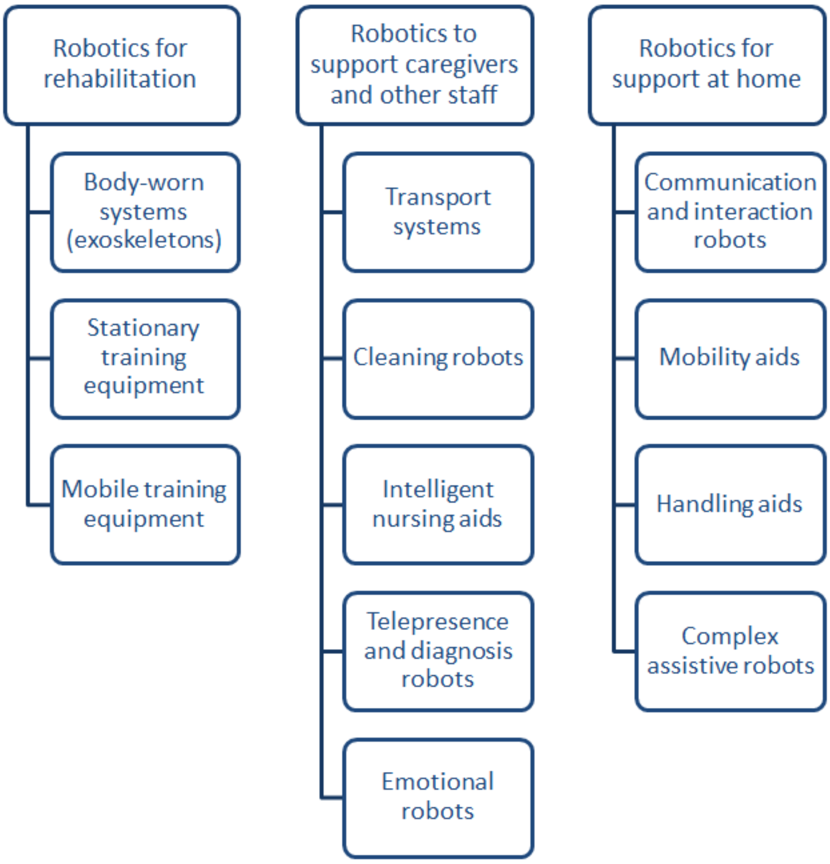

Figure 20: Application fields of robotic systems in the health care sector (adopted and translated from Klein et. al., 2018)

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3.4: Robotics for Rehabilitation

Robotic systems are used in rehabilitation of patients with paralysis of extremities as they occur in paraplegia, after stroke or traumatic brain injury. They can promote a higher number of repetitions in gait or arm exercises, which benefits the rehabilitation process. They also enable objective measurements of progress in therapy and automatic documentation on the monitor (Daum, 2017).

Robotic systems can support physical or occupational therapists in two ways: They facilitate physically heavy work and they offer the possibility to intensify the treatment if people can exercise on their own with little support (Klein et al, 2018).

3.4.1 Body-worn Systems (Exoskeletons)

Exoskeletons are exterior skeletons with servomotors that are worn like a suit (Becker at al., 2013). They support free movements of upper and lower limbs of patients with mobility disorders and can supplement traditional therapy. Exoskeletons can be controlled via simple haptic or sensor-based interfaces (Klein et al., 2018). Signals to move the device are either measured from the human body (by EMG or EEG), from the interaction force signals between the human and the exoskeletons or only from the exoskeletons (by a calculated model) (Huo et al., 2014).

Figure 21: Exoskeletons to support gait training (Pictures: Fondazione Santa Lucia)

Apart from rehabilitation, exoskeletons are also used as assistive devices for mobility in daily life. More and more, they are also considered as possibility for healthy people as support for wearing heavy goods or for nursing staff to mobilize patients (Huo et al., 2014).

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3.4.2 Stationary and Mobile Training Equipment

Robotic training equipment to practice repetitive movements can also be inpatient in rehabilitation institutions. They can support neuro-muscular training of the upper or lower extremities. Modes can be active or passive. In the active mode, the patient is moved by the robotic system, where else in the passive mode, the patient is assisted by the system to carry out a correct movement.

For lower extremities, robotic gait trainers are becoming more common. They consist of a belt system which reduces the body weight while walking (e.g., on a treadmill) and so help the individual to concentrate on the movement pattern. These inpatient systems also analyse the training units and help to evaluate the progress. Some of them are equipped with a screen where the patient can interact in a playful surrounding by executing special finger movements (in arm therapy) or walking in an outdoor environment (Klein et al., 2018).

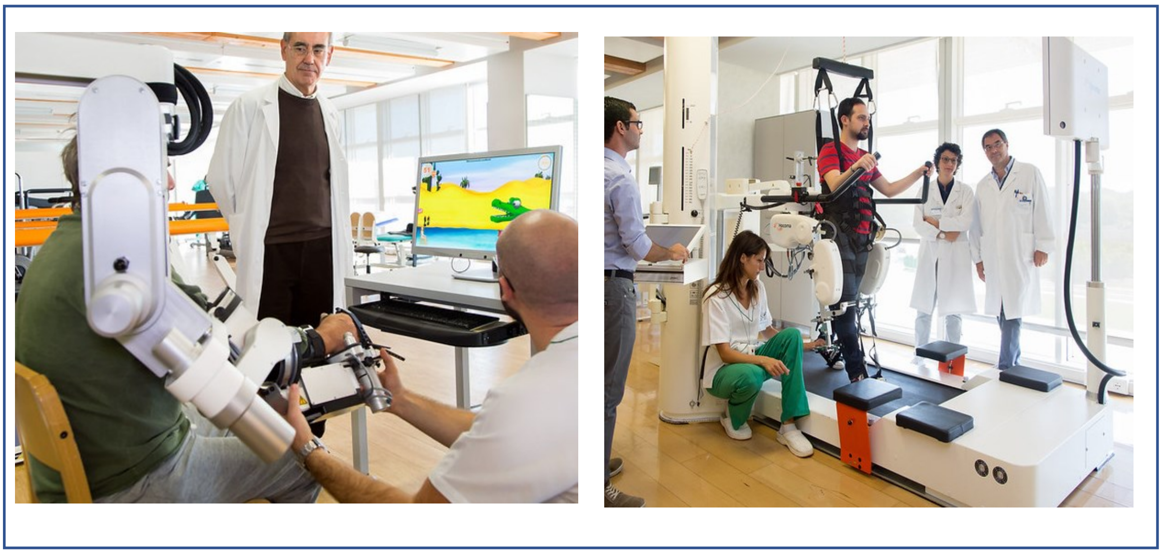

Figure 22: Stationary training devices for arm and gait training (Pictures: Fondazione Santa Lucia)

Mobile training equipment allows patients to practice walking in free space while reducing body weight with a belt system. In an early stage of rehabilitation, this can help to increase self-confidence and prevent falls (Klein et al., 2018).

<u>Advantages of robotic training systems for physical rehabilitation</u>

- The devices enable intensive therapies, longer exercise periods, good control of environmental requirements (Hidler et al., 2008)
- Greater accuracy in practice and greater treatment effectiveness (Roy et al., 2009; Zhang et al., 2011)
- The devices increase patient courage to use the paralyzed arm,

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- They document progress, and provide support and motivation when a therapist is not is available (Becker at al., 2013)

Barriers for provision of robotics for rehabilitation

- Lack of long-term evidence of efficacy
- High cost of acquisition
- Constant service needed
- Cannot replace experience of a therapist (Klein et al., 2018, Becker et al. 2013)

The use of robotic systems for rehabilitation should always include the input from an appropriate professional (e.g., a physical or occupational therapist) in a training process. As there is little evidence of transfer to ADL functions, training of motor skills should be linked to performance tasks to make sure that (re)acquired functions can be used in daily routine (Fasoli & Adans-Dester, 2019).

3.5: Robotics to Support Caregivers and Other Staff

The aim of robotics to support caregivers and other staff is to strengthen the physical and psychological resilience of caregivers and to give them more time for a direct contact with their clients. In Becker (2019, p. 237), tasks that professional caregivers desire support for are:

- Time-consuming routine work such as documentation, ordering and distributing materials, portioning medication
- Transport of material and persons within an institution
- Physically demanding work such as lifting and carrying
- Cognitively demanding work such as remembering and organising different tasks

More precisely, staff in nursing homes described robotic support in the following tasks as helpful in a needs analysis (Compagna et al., 2009):

- Transfer of clients from and in beds and bathtubs
- Automatic documentation (e.g., drinking protocols)
- Support during the night shift and in case of emergencies
- Intelligent, semi-autonomous care trolleys
- Provide clients with drinks
- Accompany them to activities
- Mobilization and localisation

In the following section, existing robotic systems for caregivers and organizations are described.

3.5.1 Logistics Robots and Transport Systems

These robotic systems aim to prevent staff in hospitals and nursing homes from walking long distances or carrying heavy goods. They can supply departments with patient/clients' meals, laundry, and medical products or dispose of waste. The use of driverless transport systems requires networking with other vehicles, the warehouse and the infrastructure (e.g., elevators). To localize,

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they use either artificial landmarks such as reflectors, magnets in the ground, lines on the ground or natural landmarks such as walls. Most systems drive under the load and lift it for transportation. Others tow the load, or the transport compartments are integrated within the system (Klein et al., 2018).

Barrier free environments are necessary to use these logistic and transport systems. As they operate in public spaces, they must be able to identify obstacles and humans, in order to bypass them (Klein et al., 2018).

Innovations in this field include intelligent care trolleys which can navigate autonomously (having been summoned with a smart phone), provide nursing utensils directly to patient rooms and document material consumption (Graf, 2020). They are not on the market yet, but show ways to facilitate medical product supply in the future.

Figure 23: The intelligent care trolley drives autonomously to his destination (Picture: R. Bez © Fraunhofer IPA)

3.5.2 Cleaning and Disinfection

Existing robotic systems for vacuuming or mopping can sense their environment using sensors and adjust their cleaning routes accordingly. They automatically go back to the charging station if run out of power or wiping water. These systems are convenient for large areas, and they document the cleaned sections (Klein et al., 2018). Remaining challenges include tasks such as, emptying trash cans, wiping down surfaces, clearing away obstacles or opening doors. Solutions for these challenges remain at a prototype stage.

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Disinfection is a very important consideration in hospitals and nursing homes to prevent the spread of viruses, bacteria and fungi. Many surfaces cannot be disinfected with liquid disinfection and in some situations, contaminated materials or rooms are not easily cleaned or should not be entered by a person. In this case, disinfection robotics can be a good solution. They use ultraviolet (UV) lights, vaporized or sprayed chemicals, and air filtration to disinfect surfaces and the air (Tectales, 2020).

3.5.3 Intelligent Nursing Aids

This is the concept that common nursing aids can be equipped with intelligent and assistive add-ons, especially to support the transferal and moving of patients or body care. For example, during the transference of people from bed to chair and vice versa or to reposition them in bed. Several assistive products exist but they may need certain muscle power, especially if the person to be transferred cannot help or they are heavy and bulky. Additionally, the aid will often have to be brought into the room before, which takes a lot of time (Daum, 2017). Therefore, several companies and research centres have worked on a solution to simplify these situations. They have created lifters which autonomously navigate to the room where they are needed and use sensors to identify and admit the person (e.g., Robear, Riken Institute or ELEVON-System, Fraunhofer IPA) or beds that transform into a wheelchair (Resyone Plus from Panasonic). Exoskeletons are also in consideration as assistive products for caregivers to prevent them from back pain (Klein et al., 2018; Merda et al., 2017).

Robotic systems to wash clients are mostly in a prototype version. Especially people who prefer assistance from a tool over a personal assistance in intimal situation might benefit from them. Experiences were collected in the EU research project I-SUPPORT[3].

3.5.4 Telepresence Robots

Telepresence systems use the concept of video conferencing on a mobile platform. They can be controlled remotely via software from a PC or smartphone. The prerequisite is a stable Internet connection.

[3] I-Support, funded from the European Union's Horizon 2020 research and innovation programme under grant agreement No 643666

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Figure 24: Different telepresence systems: TEMI (Temi Global Ltd.), VGo (Vecna Technologies) and BEAM (Blue Ocean Robotics) (Pictures: K. Türkogullari, Frankfurt UAS)

Telepresence robots can help to overcome distances. They can enable immobile patients to get in contact with a physician in rural areas or a physician can consult an expert to join in decisions. Also, a translator can be connected in case of language barriers. Telepresence systems can also help to keep a connection between immobile people and their relatives. These can navigate the platform through the home and see if everything is all right, and they can communicate via video call (Klein et al., 2018). Moyle et al. (2014) found positive aspects of using a telepresence robot for people with dementia who were able to identify their relatives by speaking to them.

Some telepresence systems are especially created for the health system. Diagnostic tools like sensors for measuring vital signs, listening to heart beats with a stethoscope or access to patient data (CT/MRI images) in an information system can be linked (Becker et al., 2013).

3.5.5 Emotional Robots

Emotional robots are commercially available and often resemble animals. They are designed in a way that emotional access is created, they can react to the behaviour of their user and can also act proactively, which is why they are often used in a similar way to animal-assisted therapy. Emotional robots are often used to stimulate people who do not respond to address or have difficulties in communication.

One of the most popular robots is the seal PARO (PARO Robots) which responds to touch with a pleasant or agonized whimper, turns its head and blinks eyes. Positive effects are reported when using PARO with people with dementia (Moyle et al., 2017), in the early support of children with

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multiple disabilities (Klein, 2011), and people with an unresponsive wakeful syndrome (Klein et al., 2014).

Figure 25: The robotic seal PARO (Picture: M. Weiland, Frankfurt UAS)

3.6: Robotics for Support at Home

These assistive robotic systems aim to maintain or increase the independence of people in their home. Assistive functions which support activities of daily living are perceived as essential by users including: washing, dressing/undressing, preparing food, transporting or picking up objects from the floor and household cleaning work. This might help to reduce dependencies on other people (Becker, 2019).

In a Taiwanese study (Chu et al., 2019), a total of 33 healthy, community-dwelling older adults (26 women, 8 men, mean age = 66.3 years) participated in semi structured interviews about an ideal robot. Participants named 4 companion-related functions and 15 service-related functions. The most desired function was service orientated: 24 participants named "doing housework" as most important, 15 people named "finding or fetching things" and 15 people wanted a robot that was able to chat with them.

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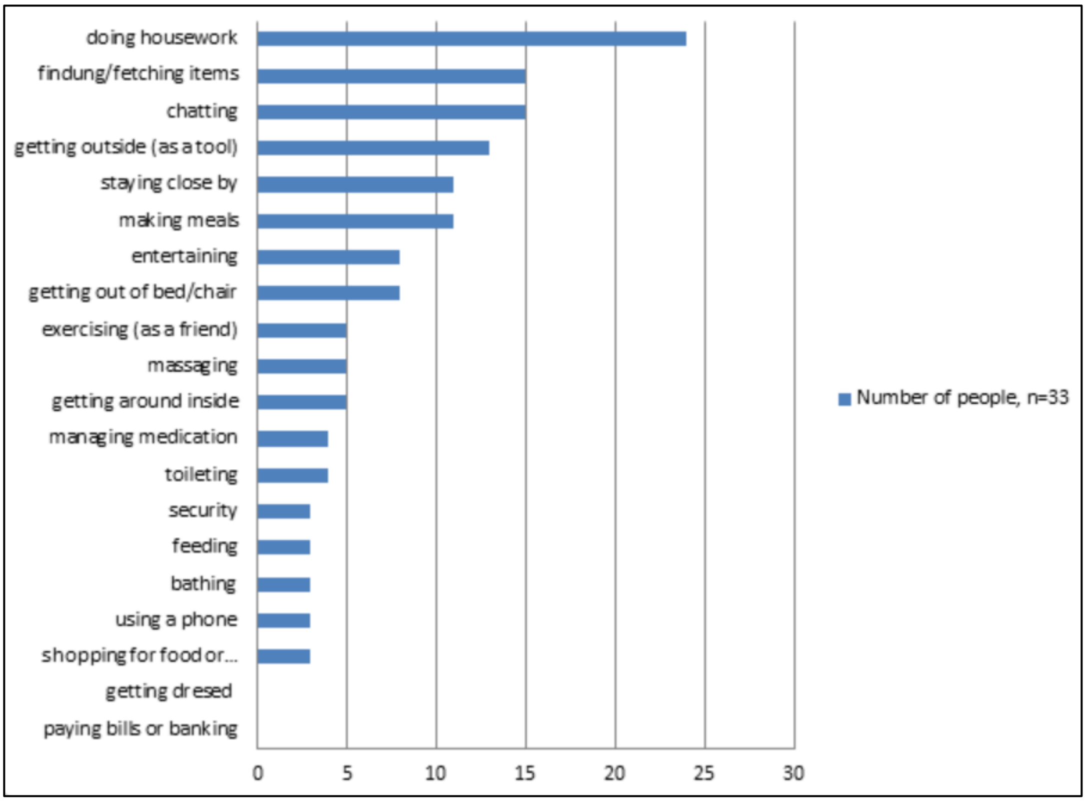

Figure 26: Preferred robot functions in old age (adopted from Chu et al., 2019)

3.6.1 Communication and Interaction Robots

Interaction robotics have functions to provide information from the internet, to remind the user of something important, to train physical and mental abilities, to play games, to enable communication with other people, and to record and forward health data. Their advantage is that they can proactively approach the user and encourage him/her to interact. These robots are used to prevent isolation, but also to monitor frail people or people with dementia and to send calls in case of emergency. In this case, they can also be linked to sensor systems in the flat like AAL applications which report abnormalities (Klein et al., 2018).

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Figure 27: The interaction robot PEPPER (Softbanks) can play music, dance and recognize people. On its tablet monitor, additional functions can be added (Picture: K. Türkogullari, Frankfurt UAS)

3.6.2 Mobility Aids

Limited mobility is one of the main causes of restricted autonomy in old age and in people with disabilities. Robotic mobility devices focus on compensating functional loss through intelligent assistive functionalities or on extending mechanical solutions (Klein et al., 2018).

Wheelchairs are equipped with tools to overcome stairs, with functionalities to avoid collision with obstacles, to follow people and to navigate autonomously. They can also be linked to different modes of control (Klein et al., 2018).

Robotic walkers can and are equipped with a variety of functionalities such as electric motorisation to assist the user when pushing; automatic speed reduction on downhill and uphill slopes, identification of obstacles as well as autonomous navigation to the user and the integration of an alarm system in case of emergency (Klein et al., 2018).

3.6.3 Handling Aids

These are mainly robotic arms that support the user in different situations. Robotic eating devices can support people with paraplegia; they either come with an integrated spoon or are able to hold cutlery or drinking vessels and lead them to the users’ mouth (Klein & Baumeister, 2020). Robotic arms are gripping aids and can pick things up from a shelf or the ground.

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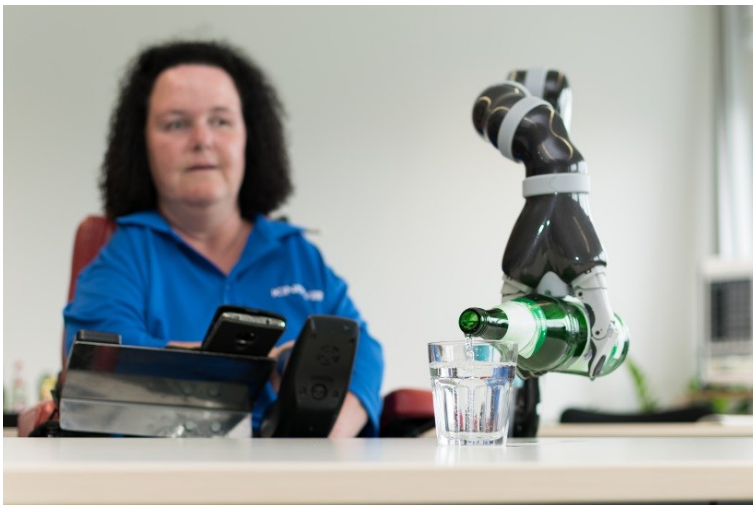

Figure 28: Robotic arm helping the user to handle a bottle of water (Picture: K. Rupp, Frankfurt UAS)

Robotic arms are controlled with a joystick or other individual control elements. The aim of research is that they can become more independent by identifying the target and the destination, they will not have to be controlled all the time of usage (Klein et al., 2018; Klein & Baumeister, 2020).

3.6.4 Complex Assistive Robots

Personal assistive robots at home aim to combine functions and features of different conceptual systems (autonomous navigation, communication and information, gripper and emergency call system, etc.) in one platform. They undertake pick-up and delivery services, take over household tasks, motivate the user to stay active and help in critical situations. These tasks are very complex, especially if the robots act in an unknown environment, where objects have no standardized places. Most of those platforms are still in a developmental stage.

Examples of assistive robots are the results of the EU project "ROBOT-ERA - Implementation and integration of advanced Robotic systems and intelligent Environments in real scenarios for the aging population"4. Platforms were created for three different scenarios (indoor, condominium and outdoor) between 2012 and 2015 and evaluated with end-users in Italy and Sweden. These platforms are organized in a cloud and can communicate with each other. DORO is the robot designed to assist indoors, it can support individuals with object manipulation by its integrated robotic arm, can transport objects, has a handle for walking support and a removable tablet. CORO can use the elevator and bring goods and waste to ORO which operates outdoors (e.g., doing the shopping or disposing of waste in bins) (Cavallo et al., 2018).

Other platforms are created by companies or research centres and universities. The Care-O-Bot (Fraunhofer IPA) which is in its fourth generation, can open doors, identify, grasp and operate objects, identify and bypass obstacles and can be an interface to other applications (Fraunhofer IPA, 2021).

[4] Funded from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement num. 288899 FP7 - ICT - Challenge 5: ICT for Health, Ageing Well, Inclusion and Governance, http://www.robot-era.eu/

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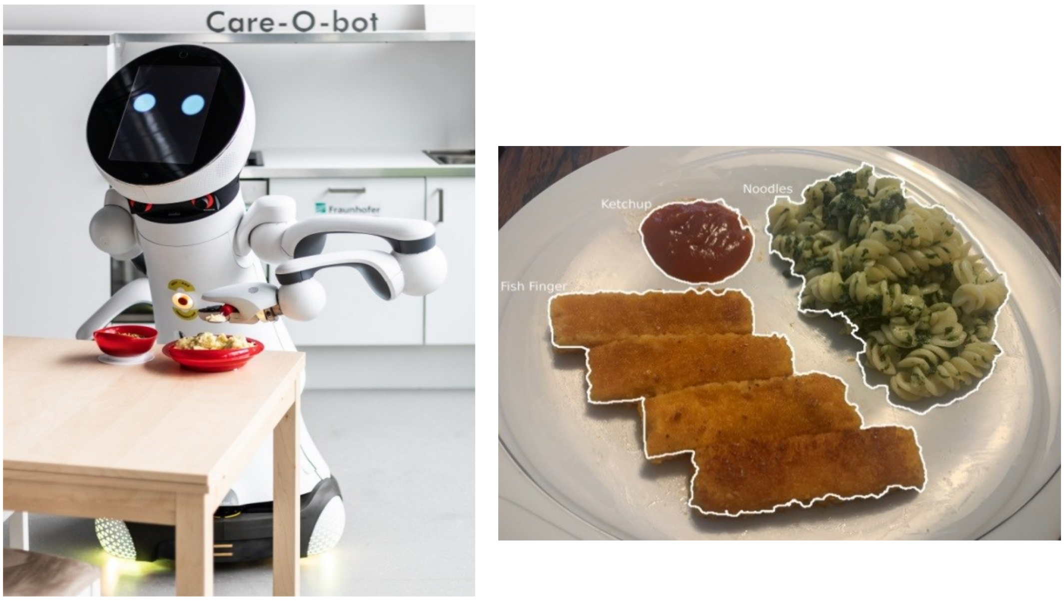

Figure 29: The Care-O-Bot 4 is able to identify food on a plate, to pick it up with a spoon and to present it in front of a person's mouth (Picture: R. Bez © Fraunhofer IPA)

The robot LIO (F&P Robotics) consists of a mobile platform with a robotic arm. It can grasp and transport objects and also learn to recognize them with its sensors. Additionally, it can recognize faces and voices, has entertainment functions and can also open and close doors. During the COVID19 pandemic, LIO was equipped with additional functions such as disinfection of surfaces and measuring body temperature (Mišeikis et al., 2020). The robotic platform is available on market. Due to the current high prices, it is assumed that it will not be used in private households until 5-10 years’ time (Ernst, 2020).

Another trend, especially in Japan, is to develop assistive robots that have an anthropomorphous embodiment. One of the challenges is to develop them with the ability to walk stably on legs (Klein et al., 2018). Another challenge is to avoid the uncanny valley, an effect, described by Mori in 1970 which proposes that people feel uncomfortable and acceptance declines significantly if the embodiment of a robot is close to a human-like appearance (Mori et al., 2012).

3.7: Robot Acceptance

A survey in the former 28 member states of the European Union in 2017 revealed peoples’ attitudes towards robots and artificial intelligence (AI). 61% of the respondents had a positive attitude, while 30% had a negative attitude (N = 27,901). Respondents in Denmark, the Netherlands and Sweden were most likely to have a positive attitude towards robots and AI with more than 80% positive

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answers. In Greece, Croatia and Cyprus fewer than half of the respondents had a positive attitude (European Commission, 2017).

Socio-demographic analyses showed that men were more likely to have a positive attitude towards robots and AI than women (67 vs. 54%). Younger EU residents had a more positive view than older ones. The level of education had also an effect: people with higher education were more positive. Additionally, the more respondents used the internet or social media the more positive their attitude was.

Asked whether they would be comfortable with having a robot at home to provide them with services and companionship when infirm or elderly, most of the EU residents were much more sceptical. Only 26% of the respondents showed a positive attitude. Residents in Poland, the Czech Republic and Latvia were most comfortable with the idea (40-45%); respondents in Portugal, Greece and Cyprus (11-13%) were least. Socio-demographic analyses showed the same effects as in general attitudes towards robotics and AI (European Commission, 2017).

3.7.1 Acceptance of Robots after Practical Experiments

Studies with smaller populations showed different opinions for the idea of having robots in peoples' home. Especially after a direct contact with a robot, participants tend to have a more positive attitude towards the robot.

A study undertaken by Beer et al. (2019) shows changing attitudes towards robots: 12 older adults (aged 68–79 years) changed their opinions in favour of the robot after being exposed to it. The robot Personal Robot 2 (PR 2) was demonstrated performing three tasks: medication delivery, operating the light switch and organizing objects. In interviews they expressed many positive reactions. Especially in terms of usefulness and perceived ease of use, the participants had more confidence in operating with a robot (the median changed from "slightly likely" to "quite likely") after the demonstration. They also showed a greater openness to robotic assistance.

After being exposed to the robots Pepper and PR 2 younger (N= 70) as well as older participants (N = 47) showed an above average openness regarding robot assistance. In both groups, consent was the highest in the activity "moving object" (e.g., to fetch things) followed by "information management" (e.g., reminding of meeting), "house work" (e.g. watering flowers) and "health" (e.g. to call a doctor). Lower consent was found for "leisure activities" (e.g., to provide entertainment) and "personal care" (e.g., washing hair), especially in the older age group (Oehl et al., 2019; Oehl et al., 2018).

In the 3-year project "SYMPARTNER" funded by the German Federal Ministry of Education and Research (BMBF), a personal assistive robot accompanied 20 elderly people in their homes for five days. The robot was perceived as supporting a variety in everyday life tasks and mitigating the effects of being alone. Participants were described as developing a personal relationship towards the robot, 12 out of 20 participants wanted to keep the robot after the experiment (Meyer & Fricke, 2020).

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3.7.2 Caregivers’ Acceptance of Robots

The experience of having practical contact with a robot seems to positively influence potential users. This also is important for (professional) caregivers. In a study by Merda et al. (2017) professional caregivers (N=576) in Germany showed a relatively positive attitude towards robots (M =3.16 of 5), even if the score was lower compared to other technologies (electronic documentation, telecare/tele medicine, technical assistance (AAL)). One factor for the lower scoring could be that participants knew least about robots.

The findings showed if respondents were more familiar with robots, the more confident they were in using robotics. The more useful respondents found robots, the more positive were their attitudes (Merda et al., 2017, p. 141).

The acceptance of robots by health care staff seems to depend on the functions the robotic platforms allow. Support in routine/service tasks is considered useful, especially in physically or mentally effortful activities. Professionals were sceptical towards the use of robots in direct contact to clients, thus replacing professional work power (Merda et al., 2017; Goransson et al., 2008).

3.8: Ethical Aspects in the Application of Robotic Systems

For the field of nursing/care Pijetlovic (2020) summarizes concerns of robotic application in literature in two dimensions: the relationship between caregiver and client and the technical-instrumental dimension.

In the first example, robotic systems are not perceived as appropriate (Coeckelbergh 2010, 2015; Parks, 2010; Vallor, 2011), because these are not able to care in an emotional way. So, a meaningful relationship could not arise. This consequence is described as a shift in focus to the technical-instrumental dimension of care (Coeckelbergh, 2015; Parks, 2010; Vallor, 2011) which can have three negative consequences:

1. Care would focus only on the material/physical dimension and objectify clients (Parks, 2010)
2. Objectification leads to clients being fooled into thinking they have a care relationship (Sparrow & Sparrow, 2006)
3. There is a danger that care clients will become socially isolated because of a decline in visits.

The author criticizes that there is no suggestion for alternatives to the nursing shortage and adds the fact that transparency of the dimensions could give the clients the possibility to choose on their own (Pijetlovic, 2020).

The German Ethics Council recommends that clients are supported to clarify their personal preferences for certain forms of care. In specific situations, the utilisation of robotic systems could be perceived differently by the individual person. Professional caregivers and organizations have to consider the individual benefit for a person and his or her acceptance. Robotics should not only be implemented to improve nursing processes, but the subjective benefit for the person also concerned must always be taken into account (Deutscher Ethikrat, 2020).

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To identify clients' preferences towards robotic systems can be difficult with people affected by dementia. These people in particular can benefit from tools supporting their independence and safety. An ethical aspect might be that they are not able to oversee to what extend they are monitored. Emotional robots can be also viewed ambiguously. These robots can be a means to get in contact with clients, to calm them, or give them the feeling of being responsible for someone's care which can reduce loneliness (Klein, 2011). These robots should not be utilized as a means to reduce human contact and care (Deutscher Ethikrat, 2020).

The implementation of robots should be adjusted on the aims and standards of good nursing and assistance: to respect the individuality of a person, especially self-determination, identity, relationality, privacy, intimacy and shame. Nursing guidelines should contain statements about which domains can be substituted by robotic technology and which domains should stay free of it to avoid interpersonal encounters becoming more difficult or rare (Deutscher Ethikrat, 2020).

3.9: Issues for Robotic Provision

Even if many people and organizations in the health and social care sector could benefit from robotic systems, they are rarely seen until now. Possible causes are described in the following section:

3.9.1 Availability of Robotic Systems in the Context of Care

Care robots are often described as a solution for the lack of qualified care staff. But until now, complex and "intelligent" robots for individual care are not available on the market. Current systems have only assistive function (Graf, 2020).

In a systematic review in 2013, Bedarf et al. identified 107 robotic systems supporting elderly people at home. Those robots claimed to provide support in four domains: mobility, self-care, interpersonal interaction & relationships, and other activities, related to the ICF. Six robots were still in a concept phase, 95 in a development phase, and only six robots were commercially available. All of the six commercially available robots supported only one activity. Three of them were for eating, one for washing and one supported interpersonal interaction & relationships (the emotional robot seal PARO) (Bedarf et al., 2015).

Since 2013, many more robotics for personal assistance have entered the market, such as robotic arms, "intelligent" wheelchairs and exoskeletons which help people walk. But as Graf (2020) outlines, many robotic solutions, especially complex assistive robots, intelligent care aids and communication and interaction robots are still primarily research platforms.

The following figure gives an overview of the state of development and availability of various robotic systems in 2020:

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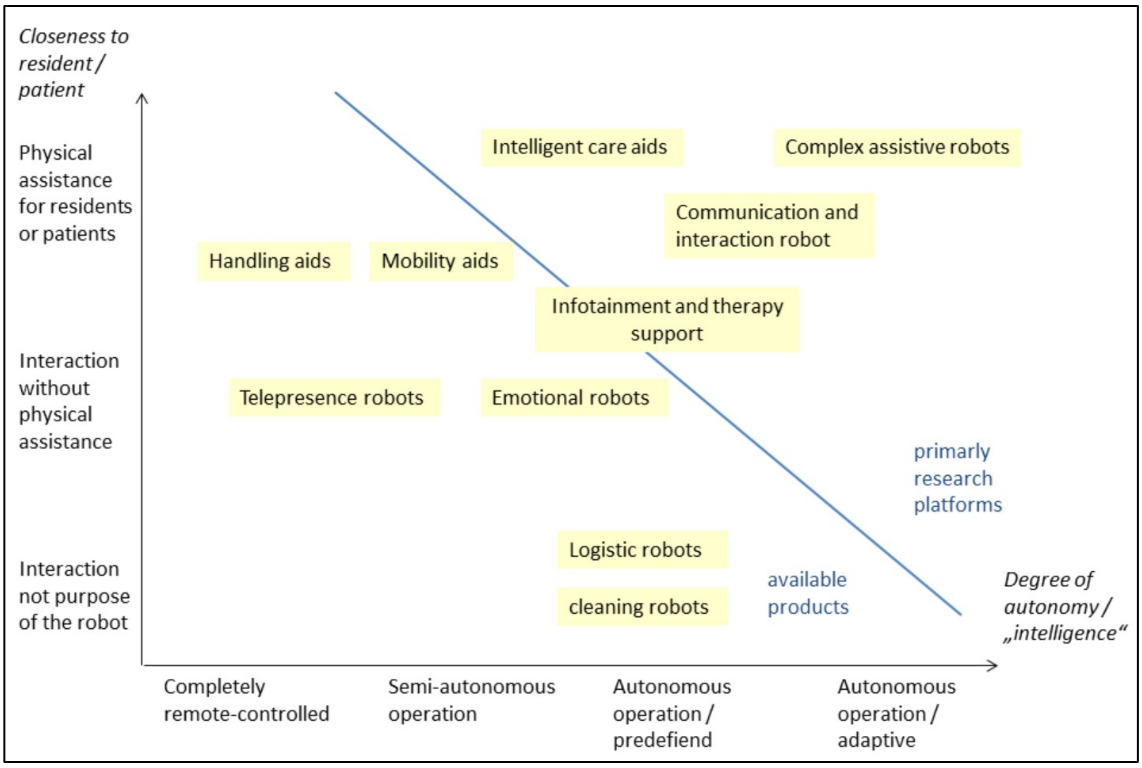

Figure 30: Available Assistive Robotic Systems (adopted and translated from Graf, 2020 © Fraunhofer IPA)

3.9.2 Implementation in People's Households and in Institutions

While industrial robots work in a standardized environment, social and assistive robots have to act in an environment where the modalities are often not prepared for a robot. Therefore, not every robotic system is suitable and often special robotics must be developed for a specific scenario. Examples for potential challenges are:

- Ensuring users' safety (Meyer & Fricke, 2020): Especially with frail or immobile users, particular care must be taken to ensure that robots do not let the user fall by approaching too fast or standing in their way.
- Constant technical breakdown has to be avoided for not overstraining the user (Meyer & Fricke, 2020).
- In small rooms, robots have to be able to navigate around furniture and over door thresholds and carpets (Gross et al., 2019; Frennert et al., 2017).
- Stairs have to be overcome, e.g., by using an elevator (Aymerich-Franch & Ferrer, 2020; Cavallo et al., 2018)
- Person identification has to be stable in different body positions and also in dim light (Meyer & Fricke, 2020).

3.9.3 Further Challenges and Barriers in Implementing Robotic Systems

Many other aspects influence the implementation of robots in institutions and people's homes.

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Stubbe et al. (2019) name four challenges. They also focus on staff as users of service robotics:

- **Physical and mental integrity**: The feeling of safety is essential for users of robotic systems. This must be taken into account during use, in that the user should not be put at risk of physical harm, but also of psychological harm (e.g. by having the feeling of being monitored all the time).
- **Change in the world of work**: The use of robots can change job profiles. When implementing robots, organizations have to address employees' fears of doing another job or even losing their job because of automation.
- **Liability and Data Sovereignty**: The use of robots can lead to legal uncertainty with regard to liability. Responsibilities are not always clearly attributable. This aspect, combined with the obligation to handle personal data lawfully under EU law, leads providers to be reluctant to act.
- **Self-determination and transparency**: Human decisions and self-determined actions should not be taken over by robotic systems. Therefore, transparency and knowledge of the capacity of the robotic system is important to be able to assess functions and their results. This leads to further acceptance.

As a result of qualitative interviews with agents in the health care system, Klein et al. (2018) name **political**, **social, legal and technical barriers** for the implementation of robots: One of the major challenges in the provision of robotics is their funding. As most of the platforms are expensive, organisations and private persons must find a way to get them financed. Organisations have to decide whether the platform is worth the investment, especially if it does not raise the income. Health politics could enable and simplify the distribution process and also support small and medium organisations. For end-users it may depend on the health system in the country if robotic devices are paid e.g., by a health insurance.

Social and legal barriers refer to acceptance, ethical concerns and data safety and security. This applies to both organisations and the private users and his/her environment. If people do not perceive the benefit of a technology, the implementation will often not be successful. Described fears are the same as mentioned before by Stubbe et al. (2019). Caregivers and end-users of robots should participate and be integrated in the whole developmental process in order to know their needs and fears and to take them into account during the development.

A technical barrier is the fact that robotic systems are often complex and cannot be operated or repaired by health or social care workers. In general, preferences are that functions are more reliable and service-oriented (Klein et al., 2018).

3.10: Perspectives

The Covid19 pandemic increased sales figures and thus, the distribution of social robots. They were deployed to facilitate physical distance in human contact, to support well-being and to act as a safeguard. Aymerich-Franch and Ferrer (2020) identified 195 experiments with 66 different social robots in an international web search, which were created during the pandemic only from March to June 2020.

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Roles that are linked to the health and social sector were:

- Receptionist in hospitals
- Pre-diagnosis (questionnaires and thermal screenings)
- Providing information (e.g., where to go next in a hospital)
- Telepresence (communication of patients in hospitals or residents in nursing homes with medical staff and relatives)
- Monitoring (to report body temperature, blood pressure, oxygen saturation, or changes in patients' routine)
- Indoor and outdoor delivery (Outdoor: food or sanitary supply; Indoor: medication, linens, meals, medical supplies and documents)
- Safety and protection (safety advice, detection if people wear masks or keep distance, patrolling)
- Disinfection
- Companion (emotional support and motivation)
- Entertainment (singing, dancing, playing games, reading news etc.) and edutainment (brain training exercises)
- Medical and wellbeing adherence (reminder for medication or engaging in healthy habits)
- Promotion of physical exercise

These examples demonstrate how exceptional situations can promote and increase innovation and the implementation of robots in new fields in a short period. However, the overview has shown that robotic systems in the health and social care sector is not yet as far advanced as it is often feared. Especially complex "care robotics" are still in a developmental stage.

And even if a majority of people – older persons, people with disabilities, caregivers, therapists, physicians – could benefit from robotic systems, there are still many obstacles to overcome.

Funding policies of the European Union and national programmes have recognised the importance of user participation as well as ethical, legal and social impact factors and integrated these throughout their funding streams. Professionals in the health and social care system and primary users, such as people with disabilities and functional loss, engage in the developmental process and can raise their needs and worries. Assumption is that the integration of these factors as well as participatory design will contribute to the acceptance of new technological developments.

In fields where robotic systems are already common, such as in logistics and also in physical rehabilitation the high costs might be barriers of implementation. Cost-benefit analyses, and in rehabilitation proof of evidence, could help to facilitate funding and to reduce costs through higher production and sales figures.

Finally, as it applies to all new technologies/developments, it is essential to qualify the user in how to use the specific robotic system and to assess the consequences of the usage. Professionals in the health and social care systems should also be able to explain the usage and potential impact to their clients in order to enable them to make their own choices.

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Topic 4: Green Information and Communications Technology (ICT)

4.1: Introduction

It is true that smart sensors help people to save energy (e.g., smart thermostats, automatic lights on presence, power consumption metering) but it is also true that these devices consume power even while they are in standby mode. Even if this consumption is quite low, imagine the high number of such installed devices all over the world. Is there a way to minimize their consumption? How can we select the less power consuming ones?

To answer these questions, we will explain first the architecture of Internet of Things (IoT) solutions. The different layers of such architecture are explained, with emphasis to those layers relevant to the consumer (sensors and data transportation). Different wireless technologies and how they affect the consumption and common techniques for saving energy in these first 2 layers are presented. Some practical examples of wearables available in the market are given.

The goal is to develop a basic understanding on how these sensors operate, the different network protocols they use to communicate, the reason why some of them (mainly battery operated) do not send data very frequently and why some research projects never reach the target market due to their power consumption.

4.2: Internet of Things

We can define Internet of things (IoT) as the network of all these sensors gathering data over the internet. These data can range from peoples' biometric data collection (medical and healthcare applications), ambient data collection in indoor building environments (smart home applications), traffic related data (smart cities applications), weather, water and soil relevant data (smart agriculture applications) and much more such as environmental monitoring to safeguarding (military).

Figure 31: Different IoT devices

There are many sophisticated applications within the Internet of Things (IoT) domain that can support people with disabilities, like those described in this unit. The energy demand of these IoT

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applications increases since sensing devices continue to grow in both numbers and their requirements.

The energy consumption can be categorized in different Layers relevant to the architecture of IoT solutions (Perception, Transport, Processing, Network and Application) (Tahiliani et al., 2018). In this unit, we will focus on the first two layers, Perception and Transportation as they have to do with the equipment that someone will purchase for using an IoT smart application. The energy consumption for the other layers is dependent on many different parameters based on the service provider's policies.

Perception and Transportation layers include components and modules with different power consumption needs. The consumption is not only a matter of hardware but it is also affected by the firmware (software embedded in the sensor) and the business logic behind each sensor (operational rules that determine how data is gathered, stored and transmitted).

4.2.1 End User IoT Architecture

End user IoT architecture covers the first two layers of an IoT solution as mentioned above (Perception and Transportation). The most common approach is the installation of a number of sensors and a Gateway to gather the data from these sensors and send them to the cloud servers and then to the end-user monitoring apps through the Internet.

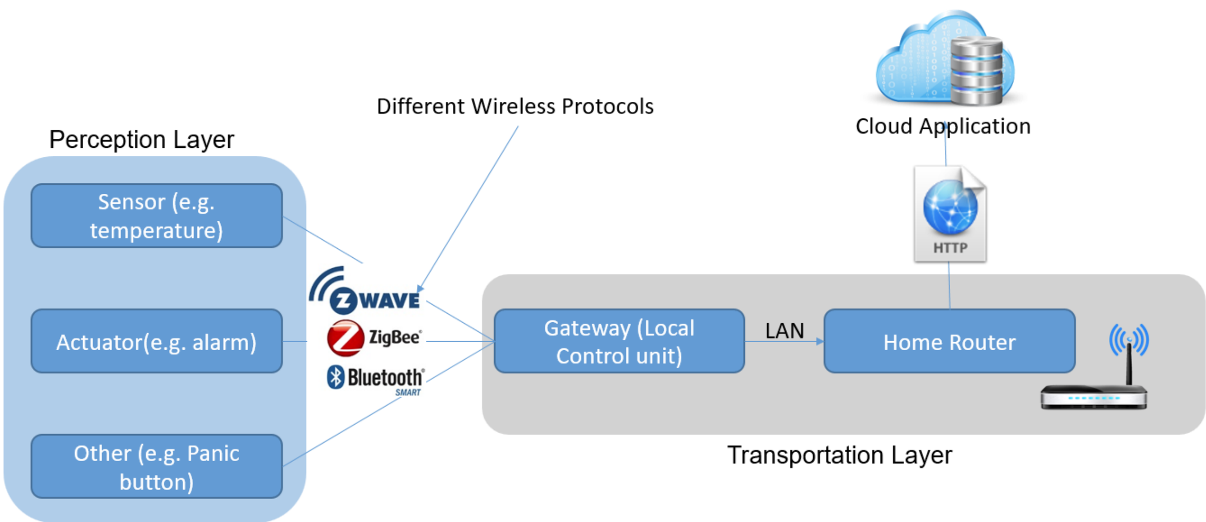

Figure 32: Common end user IoT Architecture

An alternative is to connect the sensors directly to the Cloud Application through WiFi or through GSM (Global System for Mobile communication), which is a Mobile Network like the one smartphones use. The end user IoT Architecture in this case is much simpler when used with a local WiFi, or a sim card with mobile data that can be integrated in the sensors. The latter consumes more battery and requires the user to buy mobile data. It is used mostly for remote areas where Cable Internet is not available.

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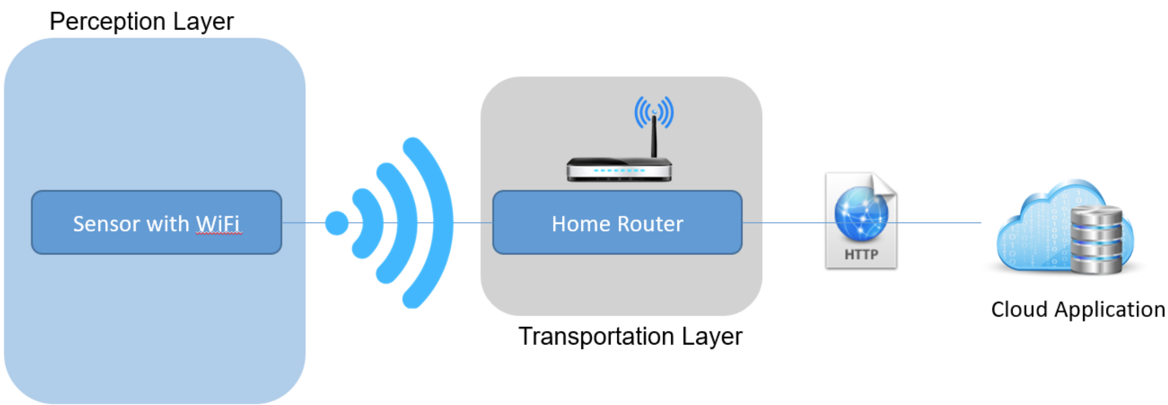

Figure 33: Simple end user IoT Architecture

Once these sensors are connected, they start reporting the sensed or measured data to the metering cloud Application. Reporting data to the cloud is very costly as every bit gets charged, this may exhaust the battery of the sensor. To address this, local scripts on the sensor can save power (e.g., transmit data when necessary, for example: (a) differentiation of the measured values or (b) when a risk is identified).

4.2.2 Energy Saving in Perception Layer

Sensors in a Wireless Sensor network (WSN) are in most of the cases equipped with a battery that in many cases is very difficult to change or recharge. Imagine an elderly person wearing a smart biometric sensor that needs to be charged every day or a motion sensor that needs to have its batteries changed once a month. In both cases, battery life can become a barrier to these sensor's missions. Prolonging the lifetime of the batteries of sensors through minimizing energy consumption is an important challenge in WSN, both for their functions but also for their environmental footprint. There exist several mechanisms to save energy in sensors such as energy efficient routing, clustering, duty cycling and radio optimization (Rezaei et al., 2012).

One of the mechanisms worth mentioning is duty cycling. A sensor usually has 4 operating modes: transmission, reception, idle listening and sleep. The most power consumption arises due to transmission and in most cases the power consumption in the idle mode is approximately similar to receiving mode. On the other hand, power consumption in sleep mode is much lower. In a duty cycling approach, energy is saved by putting the sensor's wireless communication modules in the (low-power) sleep mode whenever communication is not required. Ideally, wireless communication modules are switched off as soon as there is no more data to send/receive and should be resumed as soon as a new data packet becomes ready. In this way, a motion sensor will send data to the server whenever motion is detected, or a biometric sensor will send data when the heartbeat of the patient is outside some minimum and maximum threshold values. There are many other ways to wake up sensors like values from embedded accelerometers (when movement or a fall is detected) or scheduled wake ups to report that a sensor is alive (e.g., it's good to know that the motion sensor is functioning once per day).

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Another mechanism is to compress the data to be transmitted each time, which can drastically reduce communication energy costs. There are several researchers who have investigated optimal algorithms for the compression of sensed data, communication and sensing in WSNs (Anastasi et al., 2009, Razzaque et al., 2013).

4.2.3 Energy Saving in Transportation Layer

The transportation layer is in charge of all communications across sensors and cloud services that make up the IoT infrastructure. The connectivity between the sensors and the cloud is achieved in two ways (as also described in figures 31 and 32):

- directly, using WiFi or cellular data
- via gateways — devices performing translation between local protocols (data coming from sensors) to WWW ones.

The different protocols for sensor communication are described below:

- WiFi: WiFi offers the highest data throughput, but at the cost of high-power consumption. WiFi is adopted by many prototypes and current generation IoT devices since it does not require additional equipment for a sensor to send data to the cloud. It is likely though that WiFi will be superseded by lower-power alternatives.
- Low Power Wide Area Network (LPWAN): is a type of wireless telecommunication wide area network designed to allow long-range communications at a low bit rate. They are ideal for large-scale deployments of low-power IoT devices such as wireless sensors. The most famous LPWAN technologies are LoRa (LongRange physical layer protocol) and NB-IoT (Narrow-Band IoT).
- Bluetooth Low Energy (BLE): BLE is a type of wireless telecommunication personal area network technology aimed at novel applications in the healthcare, fitness, localization, security, and home entertainment industries. It is a low-power version of the popular Bluetooth 2.4 GHz wireless communication protocol. It is designed for short-range (no more than 100 meters) communication with a single primary device that controls several secondary devices. BLE is best suited to devices that transmit low volumes of data in bursts. Devices are designed to sleep and save power when they are not transmitting data. Personal IoT devices such as wearable health and fitness trackers often use BLE.
- ZigBee: ZigBee is a type of wireless telecommunication network used to create personal area networks like home automation, medical device data collection, and small-scale home automation applications which need wireless connection. It is a low-power and low-bandwidth wireless mesh network protocol. Unlike BLE, not all devices can sleep between bursts. Much depends on their position in the mesh and whether they need to act as routers or controllers within the mesh.
- Cellular: The LPWAN NB-IoT and LTE-M standards address low-power, low-cost IoT communication options using existing cellular networks. NB-IoT is the newest of these standards and is focused on long-range communication between large numbers of primarily indoor devices. LTE-M and NB-IoT were developed specifically for IoT, however existing cellular technologies are also frequently adopted for long-range wireless communication.

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- Near field communication (NFC): NFC is a set of communication protocols for communication between two electronic devices over a distance of 4 cm, such as holding an NFC card or tag next to a reader. NFC is often used for payment systems, but also useful for check-in systems and smart labels in asset tracking.
- Radio-frequency identification (RFID): An RFID system consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. The typical range of RFID is less than a meter. RFID tags can be active, passive, or assisted passive. Passive tags are ideal for devices without batteries, as the ID is passively read by the reader. Dash7 is a communication protocol that uses active RFID that is designed to be used within Industrial IoT applications for secure long-range communication.
- Ethernet: Ethernet is a family of wired computer networking technologies commonly used in local area networks (LAN). Sensor units installed within a building automation system can use wired networking technologies like Ethernet. Power line communication (PLC), an alternative hard-wired solution, uses existing electrical wiring instead of dedicated network cables. Ethernet can support higher bit rates, a greater number of sensors, and longer link distances while it is also the most trustworthy solution.
- 5G: 5G is the next generation of wireless networks. It is built on existing cellular technologies (4G), but it offers improved bandwidth, reliability and is about twenty times faster than 4G. 5G is ideal for the Internet of Things (IoT). It also aids the ultra-low latency requirement for real-time communications.

To give some practical examples on power consumption, it is proven that ZigBee-based networks generally consume 25% of the power of WiFi networks. Research results on different wireless connectivity protocols have proved that Bluetooth and ZigBee had significantly lower power consumption than WiFi in real life applications (Olaide et al., 2017). Bluetooth Low Energy is best for short range applications like wearable devices and smart vehicle applications, ZigBee is best for Industrial automation and robotics because it can cover a wide range, while WiFi is best for standalones (mostly in smart home applications) and mobile devices because it can implement TCP/IP and therefore the devices or nodes can connect to the Internet directly. The conclusion is that in case a product runs on batteries, it is very important to consider the networks the devices are using to estimate their power consumptions.

Figure 34: Smartwatch (Source: https://www.smartwatchspex.com/kingwear-smartwatch-kw88-3g-specifications/)

4.3: Examples on the Power Consumption of Different Wearable Devices

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Android smart watches with WiFi. There are several smart watches of this category in the market. The smart watch (actually a wearable mobile phone) measures heart rate, physical activity, sleep quality etc. It can transfer data directly to the cloud through its WiFi module, or even through GSM since it supports sim cards. The maximum battery life of this watch is not more than 8 hours, when WiFi is on. This makes it incompatible with 24x7 monitoring services, since it would need to be charged 3 times a day.

Smart watches that require connection with a mobile phone. There are several wearables that track physical activity and continuous heart rate. They should be synchronized with a mobile phone through an app and they send the data to the phone (through Bluetooth mainly) and then to a private server. In some cases, they offer the ability to write your own application and send the data from the mobile phone to an own cloud server. They have a battery life of 4+ days which is much more acceptable but the disadvantage is that they require a mobile phone nearby to populate their measurements.

Figure 35: Smartwatch (Source: Fitbit Website https://www.fitbit.com)

This difference on battery lifetime is the reason that all activity trackers that we can find in the market today need a mobile phone with an application to synchronize their data.

Figure 36: Activity tracker (Photo by FitNish Media on Unsplash)

4.4: Summary

The Internet of Things (IoT) is a key enabler for many modernized applications, from personal health care to outer space exploration. However, complicated operations (such as data transmission) consume substantial energy in contrast to the limited energy storage of IoT devices. To improve their sustainability and reduce costs, the energy efficient ("green") design of IoT is a hot topic. Duty cycling of these devices (sending data when necessary) seems to be a best practice solution to extend their battery life cycle and reduce energy consumption in general. Duty cycling is not always acceptable though. There are applications that need to gather data continuously 24x7 (like localization services). The selection of the most appropriate communication protocol is another factor that affects power consumption. Combining all the above information and playing with IoT devices settings (data transmission frequency can be found in some devices for the user to choose) can lead to reduced consumption without affecting the mission of these devices.

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Topic 5: Virtual Reality (VR) and Augmented Reality (AR)

5.1: Introduction to VR

5.1.1 Definition

Virtual Reality is a computer-generated simulation of three-dimensional environments that can be interacted with in a close to real or physical way by a person wearing a helmet with a screen inside, holding joysticks or wearing gloves or other wearable devices. The innovation of Virtual Reality is that the user can see the three-dimensional environment all around him, feeling that he is actually there.

*Figure 37: Man wearing VR headsets P*hoto by *stephan sorkin* on *Unsplash*

5.1.2 History of VR

Some of the milestones in the development of Virtual Reality hardware as we know them today are:

Stereopsis (1939) Perception of depth and 3-dimensional structure from the combination of two photographs (one eye viewing each) of the same object taken from different points. First explained in 1838 by Charles Wheatstone. View-Master created in 1939 is the evolution of Charles Wheatstone device in popular culture.

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Figure 38: Photo by Museum of Hartlepool

Sensorama (1962): The first VR machine with a vibrating chair, stereo speakers and a stereoscopic 3D screen. Created by Cinematographer Morton Heilig in 1962.

Figure 39: Picture of Sensorama

Sword of Damocles (1968): The first Head Mounted Display created in 1968 connected to a computer by Ivan Sutherland. The Headsets was depicting simple virtual wireframe shapes, which changed perspective as the user moved his or her head.

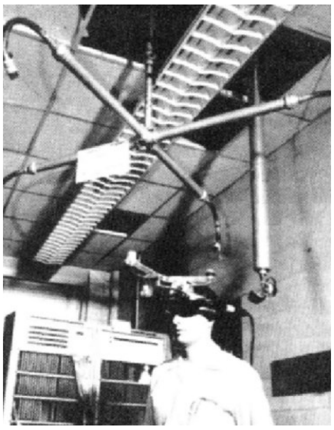

Figure 40: Sword of Damocles

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Oculus Rift (2014- Error! Reference source not found.**) and HTC Vive (2015 -** Error! Reference so urce not found.**):** Currently the most famous VR brands are Oculus and HTC Vive. Oculus has made several VR headsets models (DK1, DK2, Rift, Rift S, Quest, Quest 2) and started from Kickstarter, a crowdfunding platform focused on creativity and merchandising, where it raised 2.4 million dollars. In 2014, Facebook bought the Oculus company ($2 billion). The *HTC Vive* was unveiled during HTC's Mobile World Congress keynote in March 2015.

Figure 41: Oculus Rift

Figure 42: HTC Vive

5.1.3 Broad Applications of VR

Since the evolution of VR technology has made huge steps in realism it is now being used for many purposes, such as:

Gaming: VR is widely used for immersive, unique gaming experiences that simply aren't possible via any other medium.

Travel industry: VR tours of landmarks/museums. One of the most famous VR applications in the travel industry is Earth VR developed by Google. With Earth VR the user visit most of the places on Earth in a virtual but very realistic environment.

Education: VR offers a fun and unique learning experience for students. Virtual reality can be used to enhance student learning and engagement. VR education can transform the way educational content is delivered; it works on the premise of creating a virtual world and allows users to not only see it, but also interact with it.

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Medical Sector: VR is extremely useful in medicine for practicing and visualizing useful information. It is currently used in medical training, patient treatment, medical marketing, disease awareness, robotic surgery, mental health and psychological therapy etc.

Professional Training: VR has become an increasingly popular asset under the contemporary work environment. Especially in businesses where professional equipment is dangerous for first time users and expensive to buy and maintain, VR training is preferred (e.g., racing drivers).

Autism: Virtual Reality is one tool that is being embraced by therapists, counselors and teachers to help those with autism to better communicate with others and their environment. It is also being used to help people without autism to understand what living with the condition really means. Researchers have used the technology since the 1990s to create virtual environments to help autistic people prepare for situations that could be stressful. Some of the uses of VR in autism are:

A. Public speaking: Using a virtual environment and 3d avatars as an audience, the autistic person gives a speech to the audience which fades away if the speaker does not make eye contact.
B. Fight of phobias: Using immersive therapy, Newcastle University with Third Eye Neurotech developed Blue Room. A VR application in which the beneficiaries go through VR scenarios and perform certain tasks combined with a control panel running on an iPad controlled by an expert.
C. Social and communication skills: Using a library of scenarios taking place in virtual environments the users are trained to communicate with other people.
D. Combine perceptual, attentional, and social cognitive measures: Using a 3d videogame the players need to cooperate to solve problems in a virtual world.

5.2: Interactions that can take place in the VR Environment

5.2.1 Scope/Potential

Some of the advantages of Virtual Reality applications are:

a. **Representation of Real Environments and Scenarios Anytime at Anyplace**: Using VR real life scenarios can be represented in high accuracy allowing immersive training and giving the feeling to the users that they are physically there. It offers the ability to conduct training in a shorter timeframe and the flexibility to do so anywhere, even overseas.
b. **Improved Learning Retention**: According to a study by the University of Maryland, virtual reality training allows a user to better recall information than when using a traditional desktop display with a mouse-based interaction. VR can also enhance empathy and emotion during training, both of which help improve information retention.
c. **Safer, Controlled, Customizable and Risk-Free Learning Environments**: VR offers risk free training environments where users cannot harm themselves or others or destroy valuable equipment.
d. **Reduced Costs**: After using VR, mistakes when using the real equipment are reduced. Additionally, the VR trained users are performing faster than other peers when the time comes to deal with real-life scenarios.

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5.2.2 Limitations/Constraints

There are also some limitations relevant to VR exploitation:

a. Each VR headset can be used by one person at a time, so more time is needed for training a group of people compared to traditional methods.
b. VR is criticized for devaluing the importance of human connections. Applications that are developed should aim not to replace real life scenarios. Should aim at scenarios that carry a risk or would be impossible to recreate in real life.
c. Addiction is a potential threat. Especially when is used to meet other people.
d. Extended use of virtual reality can lead to loss of spatial awareness, dizziness, disorientation, and usually motion sickness. With VR you see movement that you do not feel.
e. Still expensive for private use, although the cost of equipment is becoming more and more affordable.

5.3: Applications of VR with Individuals with DD and ID

5.3.1 Social Communication

Social communication encompasses a range of skills that support successful interactions with other people. There are a wide variety of social skills involved in social communication. For example, there are many social skills involved in initiating and responding within conversation and social interactions. Social competence also involves the ability to recognise and respond to nonverbal social cues such as eye contact, and body language. Many social interactions are also influenced by knowledge and understanding of social norms, for example, using humour, manners, compliments, and formal/informal language in appropriate contexts. Successful social interactions are central to the development of friendships and relationships which, in turn, establish an individual's social support network. Many individuals with a developmental disorder such as autism spectrum disorder (ASD) and/or an Intellectual Disabilities experience difficulties in social communication. Therefore, developing supports in this area is critical.

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There are many challenges associated with teaching social skills. There are several successful, evidence-based teaching strategies for social skills (e.g., prompting, reinforcement, peer mediated strategies, modelling). However, there are often challenges in ensuring that these skills subsequently occur in the natural contexts within which they are needed (e.g., a work environment, with peers, on a date). Additional challenges exist when considering teaching within the natural environment to address this issue. These contexts may be unpredictable and considerable time and resources would be required to prepare the environment and those in it to support an individual's skill development. Unpredictable environments may also be challenging to navigate and learn within if an individual has difficulties with sensory input and processing. Furthermore, given that individuals with ASD and Intellectual Disabilities tend to experience specific challenges with social interactions, the potential for embarrassing or awkward consequences while practicing social skills in the natural environment may be aversive and detrimental to learning.

Within a VR learning environment, it is possible to create multiple learning opportunities and experiences for social skills. Generally, there are four distinct ways in which social skills can be supported using VR (Howard & Gutworth, 2020). Without providing any direct instruction, VR can provide opportunities to practice and repeat social skills in a *socially safe* environment (e.g., Rogers, 2017). Knowledge-based VR social skills programmes teach specific information about social skills and provide an opportunity to practice these (e.g., Klaassen et al., 2018). Emotion-based social skills programmes teach emotion regulation and coping strategies and then provide opportunities to practice these in the VR environment (e.g., Pot-Kolder et al., 2018). Some VR social skills programmes provide instruction in both social skills and emotion regulation, along with practice opportunities (Howard & Gutworth, 2020). In this way, it is possible to incorporate evidence-based teaching strategies within the VR learning environment, for example, to programme consequences for correct/incorrect social skills and responses (e.g., praise or corrective feedback) ensuring that each learning opportunity is captured (e.g., Cheng et al., 2016). Many applications of VR to teach social skills have also gamified learning and provided opportunities to demonstrate social skills with people in the natural environment (Cheng et al., 2016).

In creating these learning environments and opportunities, it is also possible to facilitate the optimum level of stimulation, motivation, minimal distractions, and to create learning opportunities that are tailored to the individual (Cheng et al., 2016; Lorenzo et al., 2018; Mak & Zhao, 2020). Given that the VR environment can be created to represent the natural environment these learning opportunities can support the extension of newly acquired social skills to this environment. As outlined, creating the same learning environment and opportunities in the natural environment would be resource intensive and challenging in many instances. As outlined previously, practicing social skills in the natural environment is complex and may be daunting for an individual with ASD and Intellectual Disabilities. There is also a risk that mistakes in this context could encounter negative social outcomes, exasperating social difficulties and anxiety. VR environments provide a *socially safe* environment in which to practice these skills, before extending to the natural environment and social interaction partners (Lorenzo et al., 2018).

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VR learning environments have been used to enhance social skills interventions through providing an opportunity for individuals with ASD and Intellectual Disabilities to experience social situations and practice social skills and responses (e.g., Andersson, Josefsson, & Paret, 2006; Leonard, Mitchell, & Parsons, 2002). The impact of VR applications on broad measures of social and emotional skills have been mixed with improvements reported in social emotional skills but not communication (Muneer et al., 2015). Research has demonstrated improvements in non-verbal communication, social initiations, and social cognition via VR (Cheng et al., 2015). In terms of specific social skills and competencies, VR has been utilised to improve job interview skills with positive outcomes on standardised assessments (Burke et al., 2018; Smith et al., 2014), interview skills, and confidence (Smith et al., 2014). Public speaking skills have also successfully being supported via VR programmes (e.g., North, North, & Coble, 2015). Case study research utilising VR has explored teaching social skills such as eye contact and recognising conversational cues (Beach & Wendt, 2014).

Recent research has developed VR scenarios to prepare children with additional needs for the transition to inclusive education through developing emotion recognition, social perception, theory of mind, and adaptive skills (Ip et al., 2016). Several studies using VR applications have demonstrated positive social outcomes for children with ASD, for example; social manners, social understanding, listening skills, social skills, perspective-taking, empathy, and eye contact (Cheng et al., 2016). Cheng et al. (2016) also noted positive reports for the VR intervention from participants' teachers, and increases in the participants' social skills toward the researchers. Herrera et al. (2008) successfully increased pretend play skills for two children with ASD.

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5.3.2 Functional Living Skills

Functional living skills are those that individuals must achieve in order to live independently and participate in essential activities in their home, at work or school, and in the community. Such activities can include self-care (e.g., personal hygiene and grooming, meal preparation, laundry), safety routines in the home or in the community (e.g., crossing the road safely), household maintenance (e.g., cleaning and tidying), navigating independently in the community, or health and medication management. Functional living skills are essential to living a safe, healthy and independent life and are of the utmost importance when supporting persons with ASD and Intellectual Disabilities.

Virtual learning environments provide realistic contexts through which individuals can learn safely from their mistakes without the often dangerous consequences produced by the real world (Standen & Brown, 2006), meaning that VR and AR offer an ideal solution for teaching functional living skills. The virtual learning environment can be adapted based on the characteristics and capabilities of the learner providing an individualised and meaningful learning experience for the learner while also maintaining ecological validity and facilitating generalisation of skills to the real world.

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Systematic reviews of the literature have found evidence to support the use of VR in learning safety skills such as how to cross a virtual street or pedestrian crossing (Matsentidou & Poullis, 2014; Saiano et al., 2015; Strickland et al., 1996; Tzanavari et al, 2015) and to teach daily living skills like doing the shopping (Adjorlu et al. 2017; Lamash et al., 2017), taking the bus (Simões et al., 2018) and driving (Cox et al., 2017; Ross et al., 2018; Wade et al., 2016).

5.3.2.1 Safety Skills and Navigation

Crossing the street safely involves an essential set of skills necessary for independent living. However, given the risks involved in teaching this skill set in the real world, it is often very difficult or even impossible to teach an individual to cross the road independently. This can result in individuals being highly supported to cross the road because there have not been safe opportunities to teach independence. The real-world environment can be substituted by a virtual learning environment to teach this skill set instead. A person can learn, with the guidance of their support worker, to follow all steps necessary to cross the road safely. For example, to recognise the pedestrian crossing, avoid moving cars, recognise and push the crossing button, wait, recognise and interpret lights, and walk on the green light (Matsentidou & Poullis, 2014).

In order to create the virtual learning experience, a VR CAVE application is used and learners wear 3D glasses to observe the virtual environment. An Xbox controller can be used by the learner or educator for navigation and interaction purposes. A fully immersive experience is created which is tailored to the individual needs of the learner. Tzanavari et al., (2015) used the VR CAVE application to teach four children with ASD (8-11 years old) to cross the road safely. Six steps were taught; namely: stopping and waiting, push button and wait for green light, look left and right, walk on pedestrian crossing and continue looking, walk until reaching pavement. Learners took part in four

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sessions in the VR CAVE during which they had four learning trials (i.e., completing all steps). Physical and verbal prompts were used at the beginning to teach the skill set; however, all learners could independently cross the road by the fourth session. This was evaluated by recording the correct and incorrect steps followed in the crossing procedure, as well as successful and unsuccessful trials. The four learners were subsequently taken to a real pedestrian crossing with their parents and it was observed that they repeated what they had learned in the VR CAVE. Parent feedback on the process was positive with the parents noting that they felt their child pulling them forward when they felt the time was right to cross.

Virtual learning environments have also been developed so that individuals can experience virtual travel training. For example, Simões et al. (2018) created an immersive VR application to allow learners to become familiar with the process of taking a bus. Learning in this context was presented as a "serious game" during which learners were placed in a three-dimensional city and had to complete a set of tasks each involving taking a bus to reach a specific destination. Learners could get on any of the buses, validate their tickets, choose a place to sit, press the STOP button, and leave the bus. Ten adolescents with ASD with a mean age of 18 took part in an evaluation of this VR application and findings demonstrated significant improvement in knowledge of taking a bus and accurate actions (e.g., ticket validation, getting on the bus) taken within the VR game.

Virtual reality driving simulation training (VRDST) can be used to teach persons with ID and DD how to drive using real-time interaction with a driving console and a virtual world. Research has found that persons with ASD may have difficulties with acquiring safe driving skills (Classen et al. 2013; Cox et al. 2012; Huang et al. 2012; Ross et al. 2015b) and are therefore less likely than peers to get a driver's licence. If they do obtain a licence, they do so much later (Cox et al. 2012; Daly et al. 2014). Barriers to acquiring driving skills can include executive functioning difficulties (e.g., self-monitoring, planning) which could make driving stressful or dangerous and difficulties with attending to relevant and important stimuli in the environment (Cox et al., 2017; Sheppard et al. 2010), for example, road hazards or pedestrians. Persons with ASD may be less likely to monitor all relevant visual fields (Reimer et al., 2013) and have difficulties with switching attention between tasks, performing sequential tasks, and co-ordinating visuomotor responses, all of which can create barriers to learning how to drive while maintaining safety.

Learning to drive plays a critical role in living independently and enhancing quality of life. Acquiring a driver's licence is associated with increased participation in further education and paid employment for persons with ASD (Cox et al., 2017; Huang et al. 2012). VRDST provides an opportunity for repeated practice in a controlled environment mimicking that of the real world. It can provide individualised training to bring attention to the skills in need of additional practice and can increase motivation to stay on task while learning to drive. Eye-tracking can also be included to monitor gaze patterns which are associated with driver competence (Cox et al., 2017; Malik et al. 2009; Pradhan et al. 2007). Fifty-one learners with ASD (15.5-25 years) took part in a study to evaluate VRDST (Cox et al., 2017) during which each participant took part in some form of the

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training. The training involved identification of individual learners' deficits, then used a driving simulator to learn to maintain lane position on straight and curvy roads, brake, stop, and maintain speed, generalise skills across rural and urban routes, use mirror and signals, navigate traffic, detect hazards and multi-task. Feedback could be provided by the trainer or automated whereby the simulator's voice provided real time auditory feedback (e.g., "too fast"). Scores on measures of tactical driving performance improved significantly.

5.3.2.2 Daily Living Skills

Shopping is an essential functional living activity. We may take our ability to execute this activity with ease for granted, notwithstanding a certain level of stress felt by many people in completing this weekly chore! However, it's an activity that requires the integration and application of a number of skills simultaneously. For example, shopping involves planning, organisation, information processing, problem solving, an ability to cope with certain stressors like interacting with staff and other shoppers, adequate knowledge of money to pay etc. Such skills can be learned in isolation but it is essential that one can integrate and apply all necessary skills in the real world, and this requires practice. Learning to integrate those skills in a real-world environment can be quite daunting, especially for individuals who find it difficult to sustain attention in busy environments and for those who feel anxious in unpredictable environments and those with arbitrary social requirements.

Creating a virtual supermarket provides a transitional stage where individuals to practice shopping tasks in a safe environment before performing a shopping task in the community. Learners can move around the virtual supermarket and perform a similar process as they would in a regular supermarket, for example, selection the products according to a list, paying for the products, and exiting the supermarket. The virtual environment can be designed to look like a supermarket familiar to the learner, for example, Adjorlu et al. (2017) designed a virtual supermarket which looked like participants' local supermarket next to their school. The layout, shelf systems and signs, and differing sections of the supermarket were modelled on the familiar supermarket. This can improve generalisation of skills to the real-world environment post-practice.

The programme can automatically track the learner's movements around the virtual supermarket and note where they stopped during the shopping task. It can also record actions in relation to

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whether or not they are considered correct or incorrect within the context of the task. For example, choosing the correct or incorrect product and putting it in the basket, choosing a manned or empty checkout, leaving the supermarket after paying or leaving before the task is complete. Learners can request hints or prompts during the process or teachers can intervene and provide a hint if they feel it would be beneficial. For example, an arrow can appear towards the direction of the next product on the shopping list. Tutorial sessions using the virtual supermarket can also incorporate voice instructions to prompt and teach the steps of the shopping task. Programmes can also automatically record the time spent in the virtual supermarket to assess any improvements in efficiency after practicing.

Adjorlu, Høeg, Mangano, & Serafin (2017) evaluated their virtual supermarket with nine children with ASD between the ages of 12-15. A between groups study was implemented over 10 days including pre- and post-intervention measures. Four participants in the intervention group completed 7 sessions, once per day, of practice in the virtual supermarket while the control group received no intervention. The intervention was mediated by a teacher as opposed to researcher implemented. Results of this study indicated that participants in the intervention group asked for help carrying out the shopping much less than they had at baseline. Requests for help were directed to the supermarket staff. Lamash, Klinger, and Josman (2017) their virtual supermarket with 56 adolescents with ASD between the ages of 11-19 years. Thirty-three participants in the intervention group took part in eight sessions. An introduction session was followed by four sessions of learning necessary skills in isolation (e.g., sorting shopping lists, using signs in the supermarket etc.). The final two sessions involved creating a shopping list according to a recipe and to perform the shopping task in the virtual supermarket. Results demonstrated a significant improvement in accuracy and use of strategies (but not efficiency) compared to the control group, on a measure of participants' ability to shop in the community.

5.4: Introduction to Equipment

5.4.1 Models/Brands/Selecting Equipment/Choosing Appropriate Equipment for Individual Service Users

The top brands right now in VR are:

Oculus Rift S: Oculus Rift S has the advantage that the sensors that track the movement of the joysticks are inside the headset, so there is no need for further location detection sensors. This makes it easy to install and use compared to the competition (e.g., HTC VIVE). It requires connection to a Windows PC to work (with specific requirements) through a cable that starts from the back of the headset.

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Figure 43: Oculus Rift – S

Its lens with a high-definition screen offers live and vivid colors and a reduced "screen-door[5]" effect. Screen resolution is 2560×1440 (1280×1440 for each eye) at 80 Hz. It includes a head belt for fast and stable positioning in the head of the user.

The movement recognition is taking place through Oculus Insight that translate the movements of the user to the virtual reality and it offers room-based tracking without the need of additional sensors.

It includes two joysticks, named Oculus Touch, that are lightweight and include a number of different buttons covering many different needs of the applications (e.g., to hold something, press something, release something, etc.). It also includes integrated sound devices that allows the user to hear the sounds from the direction they are produced.

Oculus software is required on the PC that the Oculus Rift-s will connect to. The connection is through an HDMI and an additional USB cable. The minimum requirements for a PC to support Oculus Rift S are:

- Graphics card: NVIDIA GTX 1050Ti / AMD Radeon RX 470 or greater
- Alternative graphics card: NVIDIA GTX 960 / AMD Radeon R9 290 or greater
- Processor; Intel i3-6100 / AMD Ryzen 3 1200, FX4350 or greater
- Memory: 8 GB+ RAM
- Video Output: DisplayPortTM 1.2 / miniDisplayPort (adapter is included)
- USB ports: 1 x USB 3.0
- Operating system: Windows 10

[5] The **screen-door effect** (**SDE**) is a visual artifact of displays, where the fine lines separating pixels (or subpixels) become visible in the displayed image

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Oculus Quest 2: The Oculus Quest 2 is a brand-new all-in-one VR gaming system of Oculus that does not require a PC to run. It includes a mobile device that is embedded in the VR headset. Its lightweight, comfortable, and powerful enough to run impressively detailed virtual reality experiences. Its screen resolution is 1832x1920px per eye. With enhanced clarity, the user can stay focused on whether he is on the move or standing still. Like Rift S, the movements of the user are realized through Oculus Insight that translates user’s movements inside the virtual environment. It uses Redesigned Controllers and an embedded sound system.

As anyone can understand it is the future in VR hardware.

Figure 44: Oculus Quest 2

HTC VIVE: The Vive VR headset of **HTC** (a result of cooperation with **Valve)** is the main competitor of Oculus Rift -S with better visualisation techniques and modern design.

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Figure 45: HTC Vive Headset

The HTC Vive VR Headset offers a resolution of 2160 x 1200 pixels and 110^{o} optical field, at 90 Hz. HTC Vive includes 24 location sensors that offer additional flexibility to move around to the user. It includes the VR headset, two Base Stations and two wireless joysticks.

The headset is easy to use and fits to most of the people’s heads. The effective movement space is about 3,5 * 3,5 meters. A security system named «Chaperone» alarms the user for the limits of the allocated space to avoid accidents. Its joysticks are significantly bigger than those of the Oculus Rift -s.

Figure 46: HTC Vive Controllers(joysticks)

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The base stations must be placed in permanent places, something that makes difficult to move it around.

Figure 47: HTC Vive base station for user movement and location detection

The minimum requirements for a PC to support HTC VIVE are:

- CPU: Intel Core i5-4590 or AMD FX™ 8350 or greater
- Graphics: NVIDIA GeForce GTX 1060 or AMD Radeon RX 480 or greater
- Memory RAM: 4GB+
- Video Output: 1x HDMI 1.4 or DisplayPort 1.2 or greater
- USB ports: 1x USB 2.0 or faster
- OS: Windows 7 SP1, Windows 8.1 ή Windows 10

HTC VIVE PRO: To HTC VIVE pro is the headset of HTC for advanced users. Vive Pro includes two OLED panels with maximum resolution 2880 x 1600 (1400 x 1600 per eye, at 615 PPI), significantly greater from the simple VIVE.

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Figure 48: HTC Vive PRO with eye tracking

Its greater advantage is that is support gaze tracking so it can be used for a number of serious applications where it is necessary to eye movements, pupil dilation, point of gaze, and blinking to see where subjects of a study focus their visual attention, what they engage with, and what they ignore. The requirements for the connected PC are similar to the simple VIVE.

One of its advantages compared to Oculus Rift – S is the wireless node that can be used to avoid cables between the headset and the connected PC.

Figure 49: HTC Vive wireless connector

Vive Cosmos Play: The answer of HTC to Oculus Quest 2 is Cosmos Play part of Vive Cosmos Series. Vive Cosmos Play is not requiring a PC and is the main competitor of Oculus Quest 2. Cosmos XR,

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from the same Series is a mixed-reality headset with two pass-through cameras that will depict the physical space inside the headset enhanced with Virtual objects.

Figure 50: HTC Vive Cosmos

5.4.2 Pre-requisites Needed for Use of Equipment

There are technical requirements and space requirements before using VR technology. It is very important to create a safe area without obstacles to avoid injuries while experiencing VR. All VR headsets require some form of space limits recognition before using them. The users usually have to choose whether they will use the gear moving around the physical world or standing still. If the users choose to use it while moving around the physical world, they first need to draw the limits of the play area inside the virtual world. The software then uses these limits to warn the users if they exit the play area.

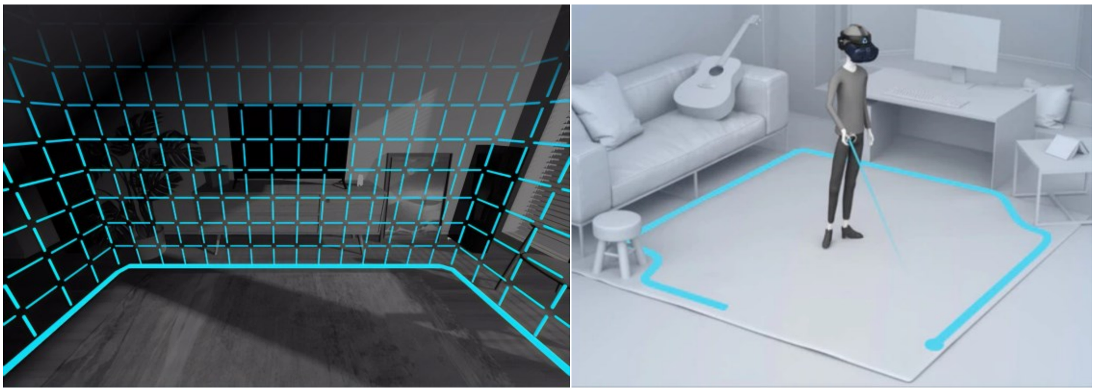

Figure 51: Setting the effective player area

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Except for the space requirements the users have to meet the technical requirements in order to use VR technology, such as those mentioned above for each deferent product. Each brand has the technical requirements for each product online for the users to see before purchasing.

Oculus and HTC differ on the requirements for the VR area. All Oculus products work on their own without any external cameras (base stations) since they are already built inside the headset. It is a different story for the HTC products since the Vive series require the setup of external cameras (base stations) that are included with the headsets. The cameras need to be placed at a certain height, positioned on the diagonally opposite corners of an imaginary square that is the play area. Recently HTC created the Cosmos series that does not require external cameras.

5.4.3 Component Parts: Pre-requisites Needed for Use of Equipment

As already mentioned in the previous paragraphs the main components of a VR equipment are:

- **Controls:** Buttons, Joysticks and pads to allow interactivity with the VR content.
- **Helmet:** The plastic mold that the user wears on his head
- **Display:** Most headsets have built-in display screens, while low-cost units will use smartphones.
- **Sensors:** Standalone devices or embedded in the helmet that provide positioning and movement information. More, usually embedded in the helmet sensors provide information for the movement / position of the headset.
- **Headphones/speakers:** One for each ear to provide immersive sound.

5.4.4 Basic Set Up

Every brand uses a software developed for their products that the users have to install. The users download the specific software and install it. After installation the software downloads all the needed libraries and begins the setup. The first part of the setup is the connection of the equipment, the headset usually has to be connected with a specific cable to the pc (if one is needed) and the controllers are connected wirelessly. After everything is connected the users have to go through setting up the guardian system.

5.5: Safety/Considerations

5.5.1 Space/Movement with Headset

Virtual Reality is a relative new technology that evolves every day and like any other new technology, there are a lot of things to take into consideration in order for the users of this technology be safe whilst using it. Since users of VR do not have visual contact with the space around them to watch out for obstacles in order to avoid injuries, the technology itself has to prevent that from happening. Every VR headset uses software that guides the users to setup the play area before using it. In order to setup the area the users have to create an imaginary square where the VR sessions will take place and clear that area from obstacles. After clearing the area,

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the user will need to draw inside the VR software the edges of it, in order for it to alert the users when they are getting close to those edges.

Every VR brand has different requirements but all of them support using the device standing still when users don’t have enough space. When the users do not choose to have a standing or seated experience The HTC software requires a minimum play area of 2 m x 1.5 m (6 ft 6 in x 5 ft) and the Oculus software a play area of 2 m x 2 m.

5.5.2 Sensory Input

A lot of negative effects have been recognized when using VR technology. Some of those negative effects are difficulty in focusing, reduced depth perception, loss of balance, nausea.

Cybersickness is the most common effect when experiencing VR. It is a form of motion sickness that happens through VR immersion. It includes loss of spatial awareness, disorientation, nausea and dizziness. The strength of the effect depends on the type of VR experience and differs for each individual. Some users don’t even notice it and others feel the effects long after they have removed the VR headset. The main theory for the cause of cybersickness is sensory conflict. The user’s brain gets movement as a visual input, but it doesn’t get the matching input from the vestibular system (the system that is responsible for balance).

Factors that affect cybersickness:

1. High Acceleration. The effect of cybersickness becomes stronger as the acceleration inside the virtual world gets higher. That is why if the change of speed is instant the effect’s strength is maximized.
2. Realism. It is suspected that the effects become stronger when the VR experience becomes realistic.
3. Movement. A known cause for the effect is irregular movement that the user is not used to (e.g., teleporting or flying).

Ways to reduce cybersickness:

1. Decrease visual input that does not match body movement
2. Use a depth of field to help the user’s eyes focus on specific things rather than the whole virtual environment
3. Avoid using VR gear for extended periods of time. Limit the VR sessions to 10-20 minutes. Taking frequent breaks helps to rest the user’s eyes.
4. Focusing the eyes on something stable

5.5.3 Time Limit

Due to the immersive experience of VR, it is very easy for a user to get lost inside and not realise time passing by. There's not enough scientific data on VR usage time to support that a user needs more frequent breaks than in normal computer use. The manufacturers usually recommend taking a 15-minute break every 30-60 minutes of usage. While taking breaks it is recommended to focus

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on static objects at various distances in the real world. It is clear that VR generates far more neural activity than gaming on a typical flat screen gaming.

Except for brain and eye effects, VR can also have effects on the user's body and muscles. Users should avoid repetitive movements in order to avoid repetitive motion injuries. It is very important when taking breaks to also move around and stretch.

5.5.4 Hygiene Protocol

When multiple users wear the same VR headset, hygiene is the top priority, especially during the covid-19 pandemic. The headset combined with the user's sweat helps bacteria and viruses multiply, also skin diseases can be transmitted with it. The biggest problem is the material the interior of the headset is made of a highly absorbent foam padding that is almost impossible to clean since it absorbs everything inside.

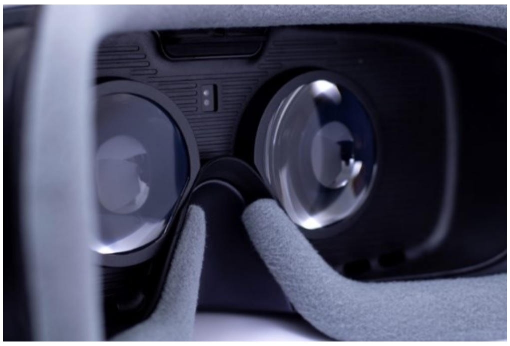

Figure 52: absorbent foam padding in VR headsets

Ways to minimize transferring bacteria and viruses from user to user:

1. Face and hand washing: Each user must always wash both hands and face before using a VR headset. After washing a hand sanitizer should be applied for best results.

2. Multiple VR foam paddings: Usually VR Brands make their foam padding inside interchangeable and you can buy new ones through their website. Having a different foam padding for each user is a very effective way to keep them safe.

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Figure 53: VR paddings

3. Using disposable VR masks: Disposable VR masks are fitted on top of the foam padding and they add an extra layer of protection.

Figure 54: VR masks

4. Towels: Each user should have their own towel to wipe their sweat every now and then, before it is absorbed by the headset's foam padding.

5. Using non-alcoholic disinfectant: Headsets and controllers should be wiped down before and after every use and once again before putting them away. It is very important not to use liquid disinfectant on the lenses to avoid causing damage.

6. UVC Disinfectant Appliance: Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (ultraviolet C or UV-C) light to kill or inactivate microorganisms. It is a very safe way to sanitize the device without harming the electronics. The only problem with UVC disinfection is that it does not work on porous surfaces.

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Figure 55: Ultraviolet germicidal irradiation disinfection method

5.6: Troubleshooting Potential Sensory Challenges

Individuals with Autism Spectrum Disorder (ASD) and Intellectual Developmental Disorders (IDD) often present with sensory issues pertaining to their interactions with their environment. The American Psychiatric Association (2013) included sensory processing issues as being one of the diagnostic characteristics for individuals with ASD in the Diagnostic and Statistical Manual of Mental Health Disorders 5th edition (DSM 5, 2013). Such sensory processing issues can be classified as either *hyper*-sensitivity (i.e., over responsiveness) or *hypo*-sensitivity (i.e., under responsiveness) to a wide range of environmental stimuli; sights, sounds, smells, taste, proprioception (i.e., body awareness), touch, and balance. For example, individuals who experience sensory issues, may find certain sounds or light frequencies very uncomfortable. The individual may find that they alter their behaviour to either avoid or escape such stimuli, or in some cases respond in a way to access the sensory input, if they find it preferred (e.g., intense smells).

Individuals with ASD and IDD can benefit from VR applications. There is a growing body of research to support the positive impact these technologies can have on teaching functional skills, social skills, emotional recognition and motor skills, to name but a few (e.g., Berenguer et al (2020). The technologies can be designed to support individuals with ASD/IDD having more focus, improved motivation and engagement. Certain stimuli can be isolated to ensure that their focus is on the task at hand, by limiting any interfering stimuli.

However, the equipment may itself present as a stimulus that elicits hyper-sensitivities for individuals with ASD or IDD. Individuals may present with sensitivities to the headsets (e.g., hyper-sensitive to pressure or touch of the head sets, or sensitivities to wearing ear phones). In any case, there are interventions that can support the individual to interact with the technology. From a behavioural perspective, the intervention should be specifically designed to meet the unique individual and environmental differences. Systematic desensitization (i.e., graduated exposure) can be an effective intervention to support the individual to learn to self-manage their reactions and become more comfortable in using the technological equipment.

In the case of an individual presenting with sensitivity to the equipment, the following steps can be adapted to meet the needs of the individual: To begin, the responses of the individual are operationalised to ensure there is an objective understanding of the behaviours associated with the sensitivity. The stimuli associated with interacting with the equipment and eliciting sensitivity responses are noted within a hierarchy from most to least. The individual is then exposed to the

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least sensitive eliciting stimulus and taught to relax in the presence of that stimulus. When the individual demonstrates mastery (i.e., coping with the stimulus) and that the sensitivity responses are no longer present with that stimulus, the individual is exposed to the stimuli in the next level within the hierarchy. In this way, the individual progresses through the hierarchy (from least to most), learning how to relax at each level until the individual is able to interact with the equipment in a productive manner, without demonstrating any sensitivity responses. Additional supports such as; role play, communication strategies, and/or social stories can be used to help support the process.

5.7: Introduction to AR and MR

5.7.1 Definition

Augmented Reality (AR) is an interactive experience of an enhanced version of the real physical world that is achieved through the use of digit visual elements or other sensory modalities. Mostly observed in mobile computing and less with the use of eye wearable devices, the user can add visual assets to a live view often using a smartphone's camera and interact with them.

Above and similar to this technology, Mixed Reality (MR) is the combination of AR and Virtual Reality (VR). While wearing a particular type of headset, this new experience connects the human and computer environment where "holograms", digital objects and physical ones can co-exist and interact in real time.

AR and MR technology have many similarities as they both visualize computer generated data in the real world but deal with some different features that will be explained.

5.7.2 Differences between Virtual, Augmented, and Mixed Reality

Virtual Reality (VR) makes user's perception of their surroundings completely based on virtual information. While wearing particular devices such as HTC Vive or Oculus Rift, It implies a complete immersion experience that shuts out the physical world and transport the user to a computer generated simulation of the environment providing him/her the ability to interact with any digital object. However, motion and interaction can be performed with the help of controllers and joysticks as the user has to define a standard point to physically stay in and not exiting while experiencing VR.

Augmented Reality (AR) as it is said before is a real-world environment experience where the objects that reside in the physical space are made and enhanced by computer vision (computer-generated graphics information). Usually performed within AR ready smartphone devices, users can add content in the physical environment and guide themselves around it, while this digital content is proving an immersive experience.

Mixed Reality (MR) is the phenomenon of merging the previous technologies (real and virtual worlds) in order to create new environments and visualization. Mixed Reality is a hybrid of reality and VR where digital assets can interact with real objects under the laws of Physics. Simply wearing a specific type of glasses users can simulate imaginary enhancements, "holograms" into the real world as if they actually exist in there. Creating "holograms" of real people to communicate, digital

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objects for users to manipulate with their hands and help industries like health, military services and education are some of the features it can provide.

Extended Reality (XR) is a technical term that covers all the previous technologies that enhance our senses, whether they’re providing additional information about the actual world or creating totally unreal, simulated worlds for us to experience.

Figure 56: Virtual Reality Photo by Minh Pham on Unsplash

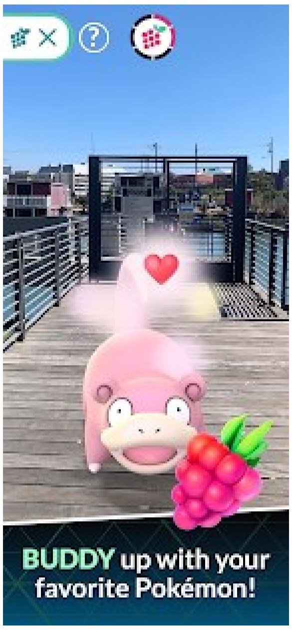

Figure 57: Augmented Reality Game Pokemon Go. Pokemons appear in the physical world through the mobile’s phone camera.

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Figure 58: Mixed Reality with Microsoft Hololens 2

5.7.3 History of AR/MR

Videoplace (mid-1970s): Built in the University of Connecticut from a computer researcher, Myron Kruger, Videoplace was a laboratory dedicated to artificial reality. Within this room, projection and camera technology was used to emit onscreen silhouettes which surrounded users for an interactive experience.

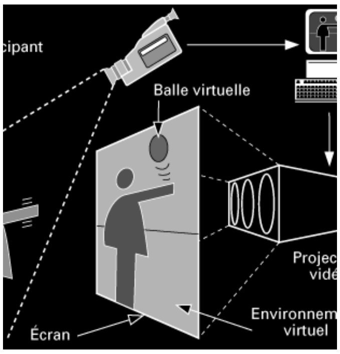

Figure 59: Videoplace, a laboratory dedicated to artificial reality

Virtual Fixtures (1992): In 1992 Louis Rosenbourg, a researcher in the USAF Armstrong’s Research Lab created “Virtual Fixtures”. One of the first fully functional AR systems, “Virtual Fixtures”, allowed military personnel to virtually control and guide machinery to perform tasks like training their US Air Force pilots. This was the first time that physical objects and digital ones interacted - today this technology is called Mixed reality (MR)

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NASA Innovation (1999): Back in 1999, NASA created a hybrid synthetic vision system of the X-38 spacecraft. The system leveraged AR technology to assist in providing better navigation during their test flights. The AR component displayed map data right on the pilot’s screen.

Figure 60: NASA's AR navigation system

Volkswagen Marta App (2013): Volkswagen debuted Marta app, a Mobile AR Technical Assistance which primarily gave technician step-by-stem repair instructions within the service manual. This adaption of AR technology was groundbreaking, as it could and would be applied to many different industries.

Figure 61: Marta App. [Article from psfk.com](psfk.com) on Pinterest

Google AR Glasses (2014): Google released in 2014 a pair of AR glasses that users could wear for immersive experiences. Capable of communicating with the Internet via natural language

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processing commands, users could also access applications like Google Maps, Google+, Gmail and more.

Figure 62: Google AR Glasses

IKEA place App (2017): IKEA place was a mobile AR app. Accessing the live view of the smartphone’s camera the customer could place visual elements in their home to see a live preview of the decor options before making a purchase.

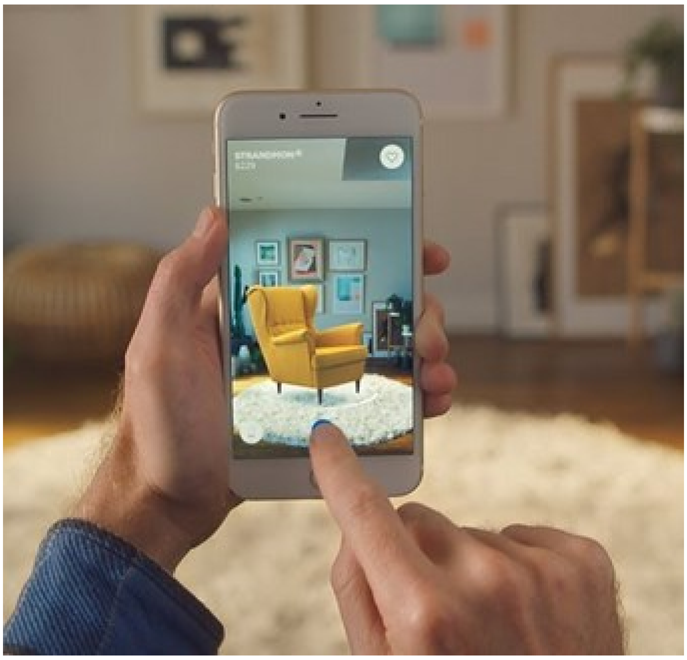

Figure 63: IKEA Place AR app

Microsoft Hololens (2016): Microsoft released in 2016 its first version of wearable AR technology called Hololens. Hololens is a more advanced AR device than Google Glasses as it is embracing the features of Mixed Reality. While letting users scan their surroundings, Hololens is able to visualize and create “holograms” that can interact with the user and the physical world, producing a higher level of an AR experience. However, due to its price it is not an everyday type of accessory.

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Figure 64: Microsoft HoloLens

5.7.4 Applications of AR/MR

Since the evolution of AR technology has made huge steps in realism, it is now being used for many purposes.

Medical Sector: There are some incredibly exciting applications for augmented reality in healthcare from allowing medical students to train in AR environments, robotic surgery, mental health and psychological therapy to telemedicine options that enable medical professionals to interact with patients. For example, AccuVein is a handheld device that can scan the vein network of a patient that leads to a 45% reduction in escalations.

AccuVein handheld and training with Hololens 2

Education: AR and MR technologies are being used within the education industry to both enhance students' ability to learn and take in information. It also gives the students the opportunity to personalize the way they learn. Using 3D projections and simulations, students can interact with and manipulate virtual objects in order to study them in a way that is relevant to themselves and their studies. An example of MR technology in education is when the Students at Case Western

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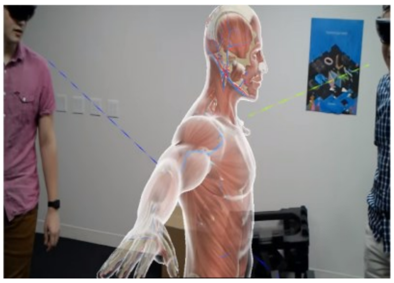
Reserve University in Ohio were able to take advantage of the Microsoft HoloLens 2 in order to learn anatomy.



Hologram visualization

Engineering: Using AR/MR devices, professionals are able to build their projects up in a shared virtual environment with a 3D modelling app. This type of detailed 3D modeling + collaboration gives engineers the best chance for spotting errors while also allowing real-time manipulation of their designs. The collaboration environment allows supervisors to evaluate and check their 3D designs in real-time.

Figure 65: Engineering with microsoft Hololens 2

Gaming: Mostly AR is widely used for immersive, unique gaming experiences that simply aren't possible via any other medium. One of the most acknowledged applications in all industries that

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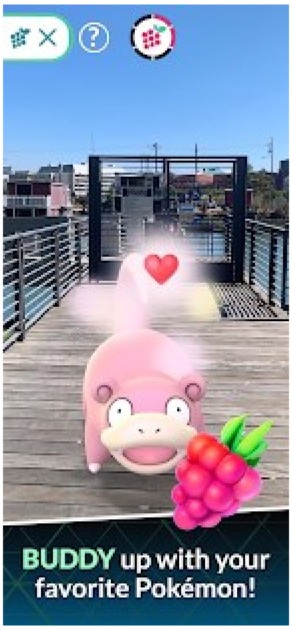
augmented reality covers is the mobile game Pokemon GO. The game offers you to locate and capture Pokemon characters which pop up while navigating to the real world.



Pokemon GO AR view

Travel Industry & Tourist sightseeing: Both AR and MR can take travel industry to another level. From mobile applications using AR indoor and outdoor navigation with or without GPS to MR application visualizing archeological findings by creating holograms.

Clothing & Accessories / Advertising: A lot of commercial companies in the industry of shopping and goods such as IKEA, Sephora, Rolex have made AR apps in order to help users visualize the products they want to buy on their room or on their body accordingly before they make the purchase.

Communication: MR technology enables immersive communication experiences that help people collaborate more efficiently. Employees can put on headsets and start collaborating without being blocked off from the real world.

Figure 66: Immersive communication experiences with AR

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Entertainment/Social Media: Augmented reality has entered, with various methods, into entertainment and social media. One of the most common aspects is the ability to draw virtual content on a human face while making a video call.

5.7.5 AR/MR Advantages

Educational Benefits: Mixed reality technologies are being used within the education industry to both enhance students' ability to learn and take in information. It also gives the students the opportunity to personalize the way they learn whereas it provides a more engaging and fun way of learning. Using 3D projections and simulations, students can interact with and manipulate virtual objects in order to study them in a way that is relevant to themselves and their studies. By inserting three-dimensional objects into a classroom as a means of gauging the size, shape, or other features of a defined virtual object, students can gain a deeper sense of understanding as to what it is they're studying. Anatomy, physics, biology are some of the scientific fields, AR and MR have a big impact on.

Manufacturing & Engineering: From 3D modeling and virtual sculpting to remote repair guidance and project monitoring apps, Mixed reality has taken the engineering sector to different levels.

- Real-time simulation of engineering processes.
- Use of MR with an industrial IoT device to monitor services.
- Engineering training.

These are some of the various ways in which the engineering sector has begun to take advantage of mixed reality devices. For example, using 3D modeling apps on mixed reality devices, professionals are able to build their projects up in a shared virtual environment. This type of detailed 3D modeling + collaboration gives engineers the best chance for spotting errors while also allowing real-time manipulation of their designs. The collaboration environment allows supervisors to evaluate and check their 3D designs in real-time.

Healthcare: One of the benefits in healthcare is training and learning into different aspects of anatomy and surgical procedures. Topics like anatomy with mixed reality technology can be used to map the different layers of the human body. Being able to produce three-dimensional models of the anatomy complete with information accessible by just a simple gesture could change the way health care and medicine is taught. MR will also transform the way in which medical students learn, using three-dimensional holograms in a virtual environment rather than two-dimensional diagrams from medical textbooks in base reality. Furthermore, in many surgeries like bone-related ones, surgical students can be taught remotely by experts as they perform surgeries in real time.

Commerce: Augmented reality applications that can reproduce real-time scenarios without buying some particular products can have a huge impact on the market. By decorating a house with digital objects or virtually wearing something can help companies advertise their products and create to customers the need to purchase the content they experienced in the AR view.

Immersive Reality: Industries like gaming, entertainment and sightseeing are enhanced with the aid of AR and MR as they deliver more attractive experiences for the users. As far as the tourist sector and travel industry is concerned, creating AR navigation systems, adding digital texts, images and information on landscapes and monuments through a mobile's camera or staring at the holographic version of an archeological area via MR devices, is something astonishing. In gaming and entertainment this technology can show all of its aspects and potentials and make us create an

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immersive and an imaginary reality. Watching, interacting with holograms and visual content gives the idea of taking part into a science fiction film.

Fitness: AR glasses that can render visual content with performance analytics onto the user's field of vision while running or biking. Moreover, AR apps like Pokemon Go can mobilize the user to walk for hours to achieve his/her goal and not sitting in front of a computer screen.

Combination with Machine Learning: Machine learning is a great aspect of computer science. These algorithms can obtain some characteristics of human behaviour. Merging the result of those programmes, like object detection algorithms and visualizing the data we receive as text on a screen for example, can facilitate many processes.

5.7.6 Scope/Potential

Besides the great impact AR and MR are having in industries like gaming and traveling where the most known apps are made, it is a technological solution that might have infinite potential to increase science and everyday life to a higher level.

Some of the great potentials of this technology are:

- Surgeries like neurosurgeries can be performed in a more efficient way as using a 3D AR projection of nerves or brain neurons can aid the process.
- Military operations can be helped as military fighter pilots see an AR projection of their altitude, speed, and other data on their helmet visor, which means they don't need to waste focus by glancing down to see them.
- Make gaming experience go to an unparalleled level combining gaming content with the real world.
- Make humans able to appear in different areas far away from their current location as holograms. This can enhance communication and also aid other processes like an experienced doctor helping in a surgery remotely.

5.7.7 Limitations/Constraints

No one can disagree that AR and MR form a fascinating and a beneficial experience. However, this kind of technology is at an early stage because in order to unlock its full potential and capabilities a lot of research and improvements both in software and hardware are required. Some of the key limitations are:

- **Price:** Augmented reality is commonly experienced through AR smartphone's devices and in fewer cases via AR smart glasses. When it comes to these devices their price is not a big concern. However, MR equipment such as HoloLens are extremely expensive for commercial use. At this point they are for developing purposes and companies.
- **Limited field of view:** One of the biggest and most obvious limitations of MR devices such as HoloLens is the limited holographic field of view. This limitation forces operators to artificially limit their head movements in order not to lose important holographic information, which in turn makes it even more important to design the information shown to the operator very carefully. More recent devices such as the Magic Leap or the HoloLens 2 have a wider field of view which probably will mitigate this issue. In AR the field of view is the view rendered from the mobile's camera.

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- **Lack of flexibility in geometry spatial mapping:** AR mobile devices scan with the aid of sensors and cameras user's environment and create a 3D geometry mesh for it where digital content can interact with. Due to its early stage, these devices can only identify and produce some basic vertical and horizontal surfaces such as walls and floor or tables, but they are unable to represent more complex geometry content.
- **Technical and sensory issues:** Further explained in a following section.

5.8: Introduction to AR/MR Equipment

5.8.1 Models/Brands/Selecting Equipment

- AR supported mobiles and tablets: There are plenty of both Android and iOS smartphones and tablets which support AR capabilities. Further details for the brands that are compatible with AR technology can be found here.

- Smart glasses: AR smart glasses are wearable computer-capable glasses that add extra information, ideally 3D images and information such as animations and videos, to the user's real-world scenes by overlaying the computer-generated or digital information on the user's real-world. It can retrieve information from computers, smartphones, or other devices and can support WiFi, Bluetooth, and GPS. Such devices are:

- **Microsoft HoloLens:** HoloLens is a mixed reality device that is powered by holograms and provides apps and solutions that enhance collaboration. With HoloLens 2, experience new heights of productivity and innovation – with purpose – to work smarter.

Figure 67: Hololens AR glasses

- **Magic Leap:** Magic Leap is a head-mounted display device worn on the forehead. It superimposes 3D computer-generated imagery over real world objects, by "projecting a digital light field into the user's eye", involving technologies potentially suited to applications in augmented reality and computer vision.

Figure 68: Magic Leap AR glasses

When it comes to deciding which device and equipment fits a solution need, one has to take into consideration the advantages of the device as much as the limitations.

5.8.2 AR/MR Device Features

Space/Movement with AR/MR device

Although physical movement in a Virtual reality is limited within the area the user has set, in Augmented and Mixed reality on the other hand, there are no such constraints. Experiencing AR and MR features through a mobile device or a headset give the opportunity to the user to guide himself/herself to any place. Obviously, the limits of the real world that restrict the user still exist in AR and MR since this technology is directly connected with the physical world.

With a mobile device the user can walk around the space either it is outdoor or indoor, moving his device in any way to get a live preview of the real environment enhanced by digital content. Wearing a headset device like AR glasses or HoloLens follows the same rules, but this time the user has to move his head in any direction while moving in his/her space.

Sensory Input

The most commonly AR ready devices are smartphones. In order to provide a fully functional AR experience to the user, mobile devices use some sensors and hardware devices to scan the surrounding, define digital elements position, etc. These devices often include a camera and microelectromechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid state compass. All these sensors receiving mathematical calculations and measurements create this experience.

- **Camera:** A digital camera that uses CMOS active-pixel image sensors which has the ability to record and analyze the real environment.
- **Accelerometer:** A sensor that can measure the linear acceleration in a three-dimensional space.
- **Global Positioning System (GPS):** GPS is a satellite-based radionavigation system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
- **Gyroscope:** Sensor used for measuring or maintaining orientation and angular velocity.

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- **Magnetometer:** A device that measures magnetic field or magnetic dipole moment. Some magnetometers measure the direction, strength, or relative change of a magnetic field at a particular location.
- **Stereo Camera:** A camera to simulate human binocular vision, and therefore gives it the ability to capture three-dimensional images, a process known as stereo photography.

Similar to AR devices, MR ones like HoloLens uses all these sensors but also more like microphones, infrared detectors and gaze trackers as it a more advanced way of approaching this technology.

5.8.3 Sensory Issues

As it was previously mentioned AR and MR devices provide a variety of features because of an enormous amount of mathematical operations, calculations and sensory measurements. Sometimes due to incorrect measurements the AR or MR application workflow can be negatively affected. Hence, it can lead to tracking loss, creating instability in the digital content for a short period of time, enough though for the user to notice.

5.9: Applications of AR with Individuals with DD and ID

5.9.1 Social Communication

Augmented reality provides unique opportunities for developing social communication and facilitating learning opportunities in the natural context (Bereguer et al., 2020). Within AR learning environments, it is possible to combine and supplement real world situations with virtual or digital content and supports in many different ways.

In particular, AR interactive stories have been utilised alone and in conjunction with other interventions to teach social skills and emotion recognition (e.g., Chen, Lee, & Lin, 2016; Chung & Chen, 2018; Cunha et al., 2016; Tentori & Hayes, 2010). AR video modelling within a storybook has also demonstrated success in supporting children with ASD in recognising and understanding nonverbal facial cues (Chen, Lee, & Lin, 2016). Social skills and social problem solving have also been successfully increased for children with ASD using AR applications (social stories, visual aids) to deliver a social competence curriculum and provide support within social interactions (mobile application) (Tentori & Hayes, 2010).

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Evidence based strategies from applied behaviour analysis have been incorporated into AR applications targeting communication skills for children with ASD (e.g., Almeida, Ramires, & Grohman, 2015; Taryadi & Kurniawan, 2018). Research has also evaluated AR and the Picture Exchange Communication System (PECS). Taryadi and Kurniawan (2018) demonstrated that an AR version of PECS supported communication skills for children with ASD. Menéndez and Lopez De Luise (2018) also adapted PECS with AR, incorporating QR codes for images, video, and sounds with positive communication outcomes.

Pretend play skills have been successfully increased using AR incorporating a mirror view of reality for children with ASD (e.g., Bai, Blackwell, & Coulouris, 2015). An augmented reality children's game application (Knights Castle) demonstrated increases in cooperative play (Farr, Yuill, & Hinske, 2010). Finally, Dragomir et al. (2018) used an AR application to encourage children with ASD to engage in pretend play with tangible objects. Augmented mirror views have also been utilised to target emotion recognition and increase social expressions for children with ASD (Chen, Lee, & Lin, 2015).

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Smartglasses-based AR systems (e.g., the Brain Power System) have been used to support the development of social communication skills for children with ASD. Gamified applications of the Brain Power System have been rated as feasible and engaging and have demonstrated positive initial results in increasing non-verbal communication, eye contact, and social engagement (Liu et al., 2017). Preliminary research has begun to evaluate the efficacy of these AR teaching applications in the natural context (e.g., school, Keshav et al., 2018; Vahabzadeh et al., 2018).

AR computer simulation programmes have demonstrated success in teaching social communication skills. Social situations and learning opportunities can be presented via interactive animations which a child can engage with (e.g., concept mapping and AR, Lee et al., 2018). A combination of concept mapping and AR supported recognition of non-verbal social cues and reciprocal greetings for children with ASD (Lee et al., 2018). Other systems combined with AR can present a visual environment and allow users to manipulate 3-D virtual characters with their body movements (e.g., Kinect Skeletal Tracking, Lee, 2020). This has successfully been applied to support children with ASD to understand body language and increase reciprocal social behaviours within this learning context (Lee, 2020). Sportsmanship and social interactions for children with ASD have been successfully targeted via FUTUREGYM, an AR interactive school gymnasium (Takahashi et al., 2018).

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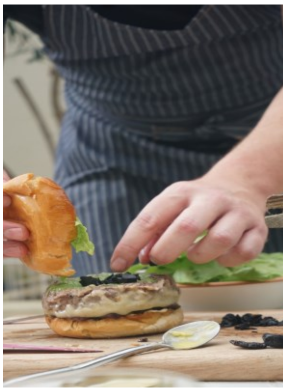
5.9.2 Functional Living Skills

5.9.2.1 Navigation

The ability to navigate and travel independently from home to selected destinations leads to increased autonomy for persons with Developmental and Intellectual Disabilities. Difficulties with independent navigation create barriers for employment, leisure activities, and engagement in the community. Augmented Reality can be used as a navigation tool using mobile devices to facilitate independent navigation to locations that were previously unknown to the person. Location-based AR applications on mobile devices have been shown to be effective for college students with ID and ASD for navigating to previously unknown locations on a college campus. Students could select a location from a list of choices on the application after which the AR view presented arrows navigating in the correct direction and text to indicate distance remaining to each destination. A comparison of paper maps, Google maps, and an AR navigation tool amongst college students with ID found that the AR application was preferred and was functionally the most effective (McMahon, Smith, Cihak, Wright, & Gibbons, 2015).

5.9.2.2 Daily Living Skills



Video modelling and/or pictures are often used to facilitate learning and prompt a sequence of steps required to complete an activity like making a sandwich, getting dressed, doing the laundry, or brushing teeth. Video modelling is an evidenced-based approach for teaching skill to individuals with ASD; however, it has been noted that a difficulty with sustaining attention to a video model may lessen its effectiveness making static picture prompts a preferred method for some learners (Cihak et al., 2016). Ultimately, a teaching approach should consider a learner's specific needs in each learning context and individualise the learning approach. Augmented reality can be used to provide both video modelling and other individualised supports to maximise learning.

Cihak et al. (2016) describe how they used marker-based augmented reality, which uses a physical marker to trigger a display of digital information, to teach three children with ASD (age 6-7 years) a sixteen-step task analysis for brushing teeth. The physical marker in this study was a five step Boardmaker visual. Using an iPod and augmented reality app, the visual was used as a trigger to a 62s video model of a same age peer brushing their teeth. The video showed all steps of the task

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analysis in sequence and was narrated. This allowed the use of both picture prompts and video models to facilitate learning. All learners' ability to perform the steps in the tooth-brushing sequence improved. Before the intervention, the learners completed between 17.5% and 34.7% of the steps independently. After between 15 and 29 sessions of intervention, they could complete all steps independently. The school staff indicated post-intervention that they found it relatively easy to use and would continue to use augmented reality to complement other teaching strategies. The learners enjoyed when the picture turned into a video and were reported to want more pictures to turn into videos.

Ayres & Cihak (2010) used augmented reality to teach three 15-year-old middle school students to make a sandwich, microwave soup, and to set the table using task analyses to outline the sequence of steps required for each. All learners received special education services and the intervention took place in the learners' resource classroom which had a computer area and a kitchen area. A computer software programme was used so that learners could practice the steps on the computer before attempting to complete each task in vivo. The computer software first presented video models whereby learners saw each step of the task analysis being performed from a first-person perspective (i.e., as if they were engaged in the activity). After this, learners had the opportunity to rehearse the steps using a mouse to progress through the task analysis to complete the tasks shown in the videos. Specific items could be selected and moved to the appropriate places to complete each relevant step. Prompts were delivered when necessary. All participants mastered the performance of the three skills in vivo after practicing using augmented reality. The in vivo setting mirrored what the students' saw on the computer so that generalisation to a real-world setting would be more easily achieved. The authors note that the use of augmented reality is a particularly viable and advantageous way to provide numerous practice sessions for such skills. The costs associated with consumables necessary for this task were reduced and it was not necessary for teachers to allocate time to provide direct instruction meaning the number of practice sessions need not be reduced based on staff time and resources.

Money management skills are another set of essential functional living skills that promote independence, participation in the community, and self-confidence. However, they are skills which may require lots of practice to master. Withdrawing money from an ATM is one such skill requiring practice; however, it would not be ideal to plan repeated practice of withdrawing money in a real-world scenario given the risks involved and the pressures which may be experienced by the learner. Kang and Chang (2019) developed an ATM simulator and interactive game called "Let's go banking!" that teaches ATM use in a game format. Each step in the ATM transaction process (e.g., entering the ATM card, keying in an access code, selecting the desired transaction and completing the transaction) was outlined using a task analysis and included in the game. Learners interacted with the simulator using an iPad touch screen and numeric keypad similar to that of an actual ATM. The simulator displayed messages which were modelled on the ATM set-up of the most popular bank in the country. Step by step visual cues were presented to assist learners through the task initially, whereby the buttons to be pressed were highlighted at the appropriate time. Using the "Let's go banking" game, three adolescents (12-15 years) successfully increased the number of task analysis

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steps carried out independently from between 27-54% of steps at baseline to 100% for all three participants post-intervention and at a 2-week follow up assessment. The participants all attended a special education class which is where the intervention took place. Teachers in the school reported that they would like to use similar games with other learners to reduce verbal prompting and direct instruction with staff, and that education should include more technology.

5.10: Advantages of using AR and VR

The use of both AR and VR learning tools can support generalization of targeted skills to the natural environment. Generalization is a critical outcome of any skill teaching programme, so that the individual can use the target skill within the contexts and situations that arise in their daily life. For example, being able to converse with friends, crossing the street safely, and preparing a meal. While one indicator of successful skills teaching is an increase in the target skill within the context in which it was taught, outcomes are most meaningful when the individual can then use that skill across contexts, situations, people, and time. AR and VR bridge the gap between the real-life context and the learning context and increased similarities between the learning environment and the natural environment support generalization (Stokes & Baer, 1977). AR supports the occurrence of learning and data collection within the natural context and VR increases similarities between the learning context and the natural context (Keshav et al., 2018). In addition, VR creates opportunities to teach skills in a similar environment where it may not be possible to teach in the natural environment due to barriers in relation to time, resources, preparation, training, and safety.

Both AR and VR are associated with increased motivation and engagement for learners (Lee, 2020; Lorenzo et al., 2018). This can also be further enhanced through individualising the learning environment, instruction, and feedback (Cheng et al., 2016; Mak & Zhao, 2020). Increased learning

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opportunities and experiences can be facilitated via AR and VR (Cheng et al., 2016; Mak & Zhao, 2020). Within a VR learning environment, it is also possible to facilitate the optimum level of stimulation for an individual, minimising distractions and supporting learning (Cheng et al., 2016; Mak & Zhao, 2020).

Additionally, it is possible to optimise these learning opportunities within VR and AR by incorporating evidence-based teaching practices. For example, roleplay can be facilitated via AR and VR (Lee, 2020). Prompts and feedback can also be incorporated within these learning environments. The use of VR or AR and evidence-based teaching strategies also creates a *safe* environment for learning. For example, making mistakes with safety skills or social skills in the VR or AR learning context does not have the same detrimental outcomes as could occur in the real-world context (Lorenzo et al., 2018). This may reduce anxiety and facilitate learning, motivation, and enjoyment.

5.11: Considerations for using VR and AR

A practical consideration when planning a VR approach to learning for persons with ID and DD is the use of equipment, in that, in some cases it is necessary to wear devices on one's body.

For example, when fully-immersive VR is used, a head mounted display must be worn by the learner. Learners will experience the VR environment (visual, auditory) as the real world and are isolated from their own physical surroundings, unable to properly navigate and interact with real objects or people. This could potentially cause difficulties for persons who experience sensory issues and as they may feel anxious if asked to wear such a device over their eyes. It would also be a potential stressor for individuals with language and comprehension difficulties who will not initially understand why you are requesting that they wear such a device if it is not explained using the form of communication understood and preferred by the learner. In addition to wearing the head mounted display, it will also be disorienting initially for a person to be fully immersed in this virtual environment.

Semi-immersive learning environments could be considered for persons who may struggle with fully-immersive VR, since less invasive equipment can be used and the learner retains a strong

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connection to the real world. Howard and Gutsworth (2020) carried out a meta-analysis of VR training programmes for social skill development and found no evidence to support the hypothesis that VR programmes using immersive displays were more effective than those using monitors. However, immersive displays should be considered as many researchers suggest that immersive displays produce better outcomes since they allow learners to become deeply involved in their experiences (even losing track of reality), and this leads to higher levels of motivation to complete objectives within the digital environment (Howard & Gutsworth, 2020).

When fully-immersive VR is chosen as the preferable and most beneficial approach for a person, some planning will be required to allow learners to adjust to the new learning environment. Learners should be given sufficient time to explore the equipment, understand how it works, and try it out.

Persons known and trusted by the learner should facilitate, guide, and model the use of the VR equipment. Should learners have language and comprehension difficulties, social stories, video or in-vivo models, and picture prompts and schedules will be necessary to enhance the learner's understanding. An initial questionnaire, completed with the learner prior to introducing VR, would be beneficial to best understand their individual needs and sensory requirements.

It may also be necessary to incorporate adaptations and modifications to the equipment being used might sometimes be possible should they cause discomfort or distraction for the individual learner. For example, Tzanavari et al. (2015) required learners with ASD to wear and interact with equipment while using VR to teach skills to safely cross the road. In this case, special footwear was provided to prevent the floor screen from being scratched as the learner walked on it. However, they found that it was not possible for the learners to wear the footwear and so they instead covered the floor screen with a white plastic film so that each person could freely walk on the floor screen in their own footwear. They also adapted how the learners interacted with the environment as they initially found that using the Xbox controller was very distracting for the learner and potentially difficult to manipulate for learners with fine motor difficulties.

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Interaction capabilities were therefore transferred to the operator to control via keyboard. For example, "pushing the button" at the pedestrian crossing was controlled via keyboard by the operator but triggered upon seeing the learner extend their arm to push the button.

Some researchers suggest that specialised input hardware (e.g., motion sensors) produce better outcomes than the use of keyboard and mouse to navigate the virtual environment. This is due to the fact that learners can feel objects and events that are not physically present allowing them to feel more present in the learning environment thus potentially leading to increased motivation to complete tasks. However, in their meta-analysis of VR for social skill development, Howard and Gutsworth (2020) did not find evidence to support the hypothesis that specialised input devices were more effective. When deciding what type of input hardware to use, instructional designers should consider the learner's individual needs and strengths, the skill being taught (is it essential to use specialised input hardware?), and the ease with which those skills can be generalised to the natural environment (consider how different the interaction with input hardware may be to how the learner will interact with the natural environment).

As mentioned, an initial background questionnaire would be of benefit in that it will provide information regarding an individual needs and sensory requirements. It can also provide valuable information regarding a person's learning history and previous experience with electronic devices. Having such information on pre-requisites allows for an individualised approach in the design of the VR environment, but also highlights certain skills that a learner may need to practice before being able to engage fully with VR. Tzanavari et al. (2015) gathered information using a background questionnaire through which they gained an initial understanding of learners' ability to carry out basic daily tasks (dressing, packing school bag) independently, use tablets and electronic devices, and their prior exposure to pedestrian crossings. Important areas to consider when assessing for pre-requisites are: the individual's history and experience using electronic devices, history of sensory difficulties, motor skills and mobility, knowledge and ability level with target skill, discrimination skills (e.g., ability to identify and select relevant stimuli in the virtual learning environment). A learner's

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language and comprehension skills should also be considered with regard to making adaptations to ensure that each individual knows what to expect in each session.

A final consideration is regarding what type of instructional approach will be used within the virtual learning environment. VR offers a learning environment conducive to practicing and mastering essential skills and facilitating generalisation to the real world. However, an individualised teaching approach should be designed based on each individual's learning needs. Virtual reality may simply provide a space to practice a new skill with no instruction, or provide explicit teaching about a skill before providing practice opportunities (Howard & Gutworth, 2020). In order to design the most effective teaching strategy, a learner's pre-requisite knowledge, understanding, and ability to carry out the skill should be assessed. This will inform on whether opportunities to practice is sufficient, or if both instruction and practice are required.

Instructional designers must also consider the most appropriate teaching strategies to be programmed into the VR environment. For example, will positive reinforcement be incorporated for engagement in target behaviours (e.g., placing correct item in shopping basket, pushing the button at the pedestrian crossing) and if so, what form should this take (e.g., simulator voice provides feedback in the form of praise, points are earned, visual feedback)? Prompts may also need to be incorporated in the virtual learning environment. The simulator voice may provide verbal guidance or visual prompts or hints may be used to guide the learner to the next step (e.g., in Adjorlu et al., 2017, arrows could appear to guide the learner towards the next product on the shopping list). As well as the type of prompt that should be deliver, when the prompt is delivered will also need to be planned. Prompts can be delivered more frequently initially while incorporating a plan to fade the reliance on prompts across learning sessions. The number of sessions required to master skill sequences to an independent level should be considered and planned for since it is more likely that learners will generalise skills learned through VR to the natural environment if they can complete skill sequences independently or with little prompting.

Similar to VR, there are aspects of learning through AR which should be considered when designing instruction or planning for its use. An initial survey or questionnaire would also be useful in this context to understand a learner's knowledge of the target skill, their ability and motivation to engage with electronic devices, and to ensure that they have the pre-requisite skills necessary to engage and benefit from AR. Ayres and Cihak (2010) required that participants had experience using a computer and a mouse and had interest in learning food preparation skills before taking part in their programme.

Kang and Chang (2019) required no physical disability that would impede use of devices, ability to attend to the screen and the programme, and ability to understand the objects in the computer

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programme before learner's could take part in their intervention to teach ATM skills. Attending was assessed by having the learners play the ATM training game while teachers observed them systematically, taking data on viewing time, reaction time and speed. This confirmed learners' ability to attend and to interact with the ATM simulator (e.g., respond to prompts on the screen). Observations were conducted for 10 minutes and the authors noted that the use of game interaction is a useful measure for attending skills necessary to engage with game-based interventions.

Acceptability, feasibility, and generalisation are also aspects to be considered when incorporating AR into skills teaching. In order to be engaged and motivated to learn via AR, it must be deemed an acceptable approach by learners. Staff must also be motivated to engage with AR and learn to incorporate it into teaching and learning. Both staff and learners should understand the advantages and limitations of learning via AR. It must also be feasible to learn via AR meaning that services and schools should be equipped with the necessary technology and devices required to teach via AR. Staff will need to upskill in order to embrace this approach fully and use AR to its full potential. When designing instruction via AR, generalisability of the skills must be considered. Consider the degree to which learners will engage in response topographies similar to those required in the natural environment. Learners may click icons or use a mouse to execute certain behaviours which will look different in the natural environment, for example, putting an item in a shopping basket. Response topographies should be as similar as is possible to that which will be carried out in the natural environment.

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Topic 6: Brain-Computer Interface

6.1: Brain-Computer Interface: Definitions and Principles

A brain-computer interface (BCI) is a technology that utilizes brain signals to control external devices (Wolpaw & Wolpaw, 2012). Under this condition, a BCI system provides the human body with an alternative artificial channel that can *substitute*, *restore* or *enhance* the natural outputs (i.e., peripheral nerves, muscles) which have been lost because of a disease or injury.

A BCI connects the brain to a computer and decodes *in real-time* a specific, predefined, brain activity.

The BCI scheme (Figure 69) illustrates the principle of a BCI, which relies on direct measures of brain activity (a), provides feedback to the user (c), operates without delay, and relies on intentional control.

Most BCI research has been focused on helping people with severe motor disabilities to interact with external devices.

BCI applications are the following:

- BCIs can **replace** functions that were lost due to injury or disease: for example, can replace communication and wheelchair control.
- BCIs can **restore** lost functions, such as stimulation of muscles in a paralyzed person and stimulation of nerves to restore bladder functions.
- BCIs can be used to **improve** functions: e.g., by supporting motor rehabilitation in stroke rehabilitation.
- BCIs can **enhance** functions: e.g., detection of stress levels or lapses of attention during demanding tasks.
- BCIs can **supplement** functions: for example, control a third arm or eye.

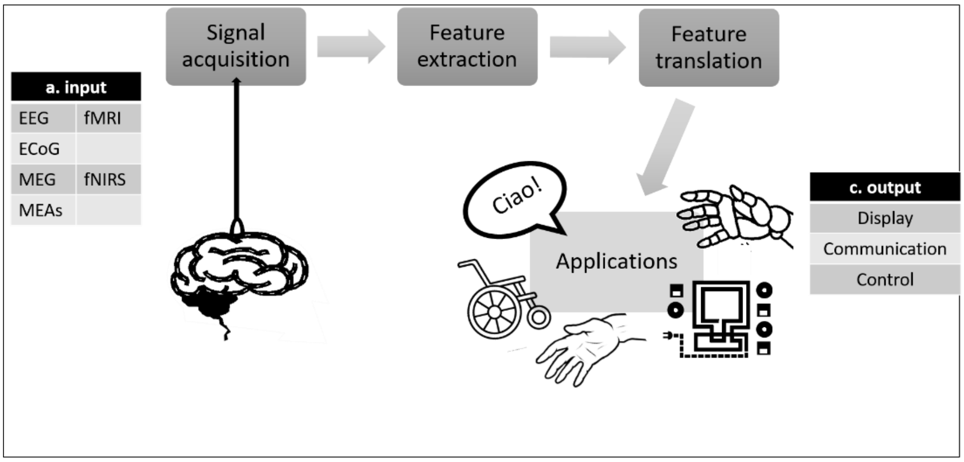

Figure 69: Functional blocks of a BCI system

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6.2: History

Since their inception in the early 1970s, BCIs have been a fascinating topic for scientists. Right now, BCIs are on the verge of evolving from lab prototypes into useful real-world products.

In 1973 Jacques J. Vidal published some theoretical and technical suggestions for direct brain-computer communication (Vidal, 1973): he outlined all the elements necessary to build a working BCI. The components were, three displays, required for the "experiment room" and an amplifier, comprising two screens and a printer, for the control and computer areas. The person's electroencephalography (EEG) was transmitted from the experiment room to the amplifier: Vidal vision consisted of using the brain to control a computer (Figure 70).

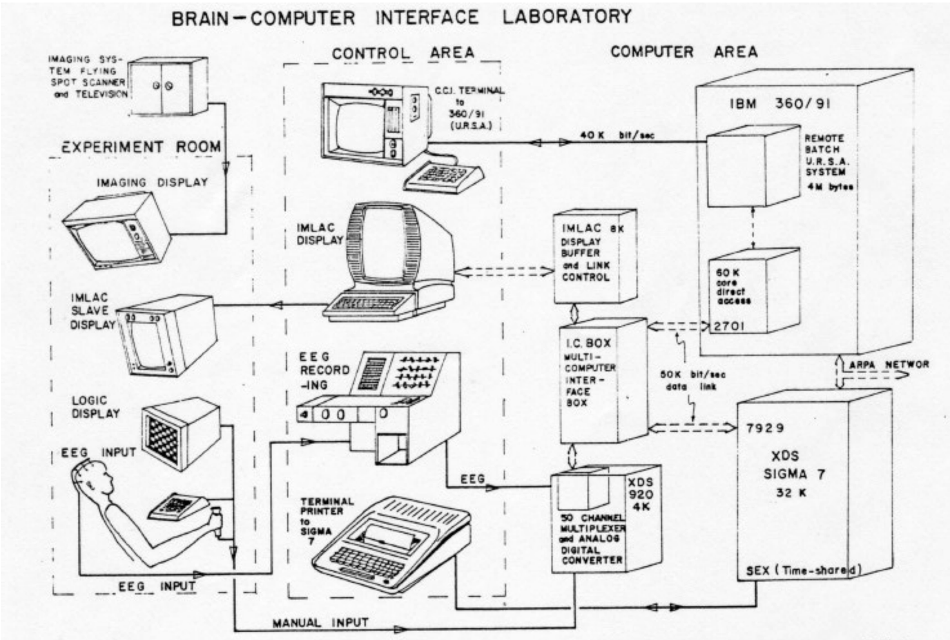

Figure 70: A BCI Scheme in 1973 (Vidal, 1973)

In parallel, the biofeedback field was proceeding since 1950, by proving that in humans, autonomous responses could be controlled voluntarily when online feedback on the response is provided, without the support of the voluntary muscle system (Taub, 2010). The biofeedback (which comprises the neurofeedback technique) consists of real-time feedback of physiological signals to the subject that produces them (Kübler, 2019). Besides, the final aim of BCIs consists of controlling an external device using the biological (brain) modulation. The difference consists of the fact that the regulation of bio (brain) activity is the final goal of traditional biofeedback, but the required mean to control an external application (device) in BCI. Neurofeedback is indeed a neurocognitive therapy based on human-computer interaction. The objective of neurofeedback is to enable subjects to voluntarily train and modify functional biomarkers that are specific to mental disorders, to improve symptoms or cognitive processes.

Neurofeedback experiments led to the development of the brain-computer interfaces (BCIs) in which individuals aim to directly regulate external devices instead of neural substrates.

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6.3: General Frameworks for Brain-Computer Interfaces

A BCI consists of an *input* (e.g., brain activity from the user), an *output* (i.e., device commands), components that *translate* input into *output*, and a protocol that determines the onset, offset, and timing of operation (Figure 69).

Input (Figure 69a.). The input consists of the brain activity recorded from the scalp. Such recording can be performed by means of a range of metabolic methods.

Features of the digitized signals (*input*) are extracted by means of a variety of procedures i.e., spatial filtering, voltage amplitude measurements, spectral analyses and *translated* in user's messages or commands (*user's intention*) (Mak et al., 2011; Padfield et al., 2019).

BCIs can use signal features that are in the time domain (e.g., evoked potential amplitudes) or the frequency domain (e.g., mu or beta rhythm amplitudes). The first part of signal processing simply extracts specific signal features, which are translated, in the next stage (the translation algorithm) into device commands-orders that carry out the user's intent. This algorithm might use linear methods (e.g., classical statistical analyses) or nonlinear methods (e.g., neural networks). Whatever its nature, each algorithm changes independent variables (i.e., signal features) into dependent variables (i.e., device control commands) (Lemm et al., 2011).

Output (Figure 69c.) device can be a computer screen where BCI allows the selection of items (targets, letters, icons) or the cursor movement. A BCI can also control a neuroprosthesis or an orthosis, or other electrical devices, such as a domestic appliance or wheelchair.

The BCI has a *protocol* that manages its operation: by defining how the system is turned on and off, whether the communication is continuous or discontinuous, whether message transmission is triggered by the system or by the user, the sequence and speed of interactions between user and system, and the feedback provided to the user.

6.3.1 INPUT: Measurements of Brain Signals for Brain-computer Interfaces

The brain signals, directly subserving as inputs to BCI systems, can be recorded in a variety of electrophysiological and metabolic methods (Coyle et al., 2004; Hinterberger et al., 2004; Weiskopf et al., 2004). The brain activity can be measured *directly* via the electrical activity of the cells or *indirectly*, by measuring the blood oxygen required by active nerve cells. Methods also differ in terms of *temporal resolution* related to how the measured activity corresponds to the timing of neural activity- and *spatial resolution* referring to how well a method discriminates between nearby locations.

- *Temporal resolution* is defined as the amount of temporal details in an observation and it refers to the ability to identify exactly when an activation happens (i.e., the shorter is the time interval that can be acquired the higher will be the temporal resolution).
- *Spatial resolution* is defined as the amount of spatial details in an observation and refers to the ability to identify exactly which area of the brain is active (i.e., the smaller is the dimension of a pixel that can be acquired the higher will be the spatial resolution).

Direct methods

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Direct methods include **invasive** measurements, i.e., the electrocorticography (ECoG) and multi-electrode arrays, and **non-invasive** techniques i.e. magnetoencephalography (MEG) and EEG.

The use of **invasive BCIs** involves surgical implantation of electrodes or multi-electrode grids; Invasive BCIs measure activity patterns of neurons, which encode behaviourally relevant information.

Non-invasive BCIs require no surgical implantation and enable the recording of brain signals from the external surface of the scalp. EEG is the most widely non-invasive-used method for recording brain activity in the BCI field: this session will go deeply EEG-based BCI.

6.3.1.1 Invasive Brain-Computer Interfaces

Multi-electrode arrays (MEAs) are arrays introduced into the cortical surface. MEAs allow the recording of local field potentials (LFPs), multi-and single -unit activity. MEA-based BCI research is mainly performed with non-human primates and has demonstrated the feasibility of MEA signals to control a prosthetic arm in several directions for self-feeding (Velliste et al., 2012).

Studies including human participants have enrolled people with tetraplegia, and have demonstrated multidimensional control over computer cursors and artificial limbs using motor imagery (Hochberg et al., 2006). Despite these promising results, reports on long- term recordings with MEAs (Lee et al., 2013) on tissue reaction, tissue damage and the associated signal loss remain an issue of concern (Nicolas-Alonso & Gomez-Gil, 2012; Shih et al., 2012a). Approaches currently being investigated to address this issue are biocompatible coatings, optimized algorithms or using LFPs or multiunit recordings (Gilja et al., 2011; Lee et al., 2013). Attempts to further improve and extend the usability of MEA BCI systems are the development of wireless solutions (Chestek et al., 2009; Schwarz et al., 2014; Yin et al., 2013).

Electrocorticography (ECoG) measures fields generated by large groups of neurons, using cortical surface electrodes. ECoG--based BCI control can be based on spectral power changes in isolated brain areas (Shih et al., 2012a) or Event-related potentials (ERPs; see Song et al., 2012), see section 6.3.2.1. ECoG-based BCI research is mainly focused on the (motor function) replacing applications and is mostly performed with patients suffering with epilepsy with subdural subchronic implants (Ritaccio et al., 2011). The possibility to control a cursor (1-3 dimensions), a prosthetic hand and a virtual keyboard (speller) by means of a ECog-based BCI have been demonstrated by acquiring signals based on motor execution, motor or sensory imagery, working memory, visual attention and overt or imagined articulation tasks (Andersson et al., 2011; Shih et al., 2012a; Vansteensel et al., 2010; Zhang et al., 2013). Regarding the long-term stability of human ECoG recordings, recordings over multiple days in humans and multiple months in animal studies are promising (Chao et al., 2010; Henle et al., 2011; Moran, 2010). One study has reported on an ECoG--based BCI for cursor control in a tetraplegic patient lasting 28 days before explantation (Wang et al., 2013). Typical ECoG implants are grids and strips of electrodes with 1 cm interelectrode distance (approved for subdural use for 28 days), but new ECoG grids, ranging from closely spaced electrodes to actual high-density micro-electrodes are also becoming available.

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6.3.1.2 Non-invasive Brain-Computer Interfaces

Magnetoencephalography (MEG) measures the magnetic fields caused by currents within the brain (Hansen et al., 2010). It is a direct measurement of neural activity with high time resolution (Baillet, 2011). A limited number of studies have demonstrated successful implementation of MEG--based BCIs (Mellinger et al., 2007), but a limitation of the research field could be identified in the high cost and physical constraints of the measurement device (i.e., size, requirement for magnetic shielding) (Nicolas-Alonso & Gomez-Gil, 2012; Shih et al., 2012b).

Electroencephalography (EEG) is the most popular non-invasive method for signal acquisition in BCIs. It records electrical activity of neural assemblies using sensors placed on the scalp. EEG has very high *temporal resolution*, on the order of milliseconds. EEG has a low spatial resolution, but it is portable and relatively inexpensive. Lastly the EEG signal is susceptible to many types of artefacts (see box 1).

Electrical signals produced by the brain are in the order of microvolts. The EEG amplifier magnifies brain signals so that the voltage changes can be graphically displayed on a computer screen.

Main characteristics of the EEG amplifier are:

- The number of electrodes (i.e., acquisition sites) it can record from.
- Sampling Rate: the number of times that the signal is measured per unit of time, usually given in Hertz (Hz) = 1/second. Indeed, although the EEG is an analogue signal (continuous in time), it has to be converted into a digital signal (discrete in time) in order to be processed by the computer. The EEG signals carry information within a bandwidth between 0.5 Hz and 80 Hz. The sampling rate has to be at least twice the maximum frequency of the signal being measured.
- Bandwidth: the effective frequency band that the EEG system can measure according to the sample rate and the internal filters of the amplifier.
- Input range: the maximum amplitude signal that can be recorded before saturation. EEG amplifiers need to have an input range that comprises the minimum and maximum values of the EEG signals (V), but also those values from other physiological/mechanical processes that interfere with EEG, including EOG (V), EMG (mV) and offset voltages (mV).

BOX 1
ARTEFACTS IN BRAIN COMPUTER INTERFACE RECORDING
Wolpaw et al., 2020

Artefacts in BCI can depend on:

- the environment: electromagnetic noise form power lines of appliance.
- the body: muscle activity (electromyographic activity, EMG), eye movement (electrooculographic activity), cardiac activity (electrocardiographic, EKG), body movements.
- the BCI hardware: electrode/tissue interface instability, amplifier noise.
- the BCI software.

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Indirect methods

Indirect methods include functional magnetic resonance imaging (fMRI) and functional magnetic near infrared spectroscopy (fNIRS).

Functional magnetic resonance imaging

Functional magnetic resonance imaging (fMRI) measures the hemodynamic response to neural activation in the brain. It reveals locations with changes in oxygenated and deoxygenated blood flow and volume (Hillman, 2014), by using blood -oxygen -level dependent (BOLD) contrast imaging methods. The main advantage of fMRI is its high spatial resolution.

Although physical (e.g., size, strong magnetic field), methodological (e.g., low temporal resolution, delayed haemodynamic response), and financial aspects constrain fMRI for most BCI applications (Nicolas-Alonso & Gomez-Gil, 2012), there is an increasing interest to use fMRI for detecting consciousness (Cruse et al., 2013), neurofeedback training (Weiskopf, 2012) or to pre-localize regions for subsequent electrode implantation (Shih et al., 2012b; Vansteensel et al., 2010).

Functional near infrared spectroscopy

Functional near infrared spectroscopy (fNIRS) is an emerging non--invasive optical technique for the assessment of cerebral oxygenation (Boas et al., 2014; Ferrari & Quaresima, 2012). Similar to fMRI, fNIRS measures hemodynamic changes in the brain, but fNIRS is less expensive and more portable than fMRI (Nicolas-Alonso & Gomez-Gil, 2012). BCI applications studies demonstrates fNIRS technique feasibility as an alternative to (Sitaram et al., 2007) or in combination with (Fazli et al., 2012; Gert Pfurtscheller et al., 2010) EEG, the last due to the complementary nature of fNIRS and EEG: fNIRS measures BOLD responses, which are typically slow and have a strong delay relative to the underlying neuronal events.

BOX 2
How to arrange an EEG-based BCI

1) EEG electrodes
Traditional EEG sensors (active and passive electrodes) need gel to low impedances.

Some alternative approaches are based on water or dry electrode (that don't need gel to low impedances). Usually, the electrodes are mounted on a cap so that they can be quickly positioned. The positions of the electrodes refer to the 10-20 system (or 10-10/10-5 depending on the number of electrodes to be used). After the subject has put on the cap, the operator has to put conductive gel between the scalp and each electrode (see figure 70) in order to lower the impedance (typically < 5KΩ).

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Figure 71: The operator is putting conductive gel between the electrodes and the scalp od the user.

2) Amplifier
Signals acquired from the electrodes go through the EEG amplifier which is the part of the data acquisition system responsible for accommodating, amplifying and converting the analogue electrical signals from the sensor into a digital signal that can be processed by the computer. Many current EEG systems ship with active electrodes, which include small preamplifiers directly located on each electrode.

3) BCI software
When the EEG signal is considered reliable, the operator configures the BCI software with the specific parameters for the individual subject (e.g., Subject Name or Session Number) and the BCI task (e.g., type and features of targets on the screen, stimulation timing, etc.).

4) Calibration
Calibration allows to extract subject's specific parameters from EEG signal to be used to control the BCI. Usually, during the calibration phase, subjects are asked to perform a well-defined task (e.g., to imagine the movement of a hand or to focus attention on the flashing of a specific letter) in order to acquire labelled data to train later the classifier for BCI Control.

5) Online
Once subject's specific control parameters are extracted with special tools and loaded in the BCI software, the subject will be able to control the BCI (e.g., to control a cursor on the screen –or to write words by spelling letters).

6.3.2 Feature Extraction

Feature extraction is the process to extract a meaningful content from the human brain to be interpreted by the computer.

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The development of BCI processing and classification algorithms aims at providing the best performance (accuracy, speed, throughput etc.). There are three kinds of components (i.e., spectral power changes, ERP, steady-state evoked potential (SSEP)) that can be exploited by BCI systems based on EEG. For example, when extracting **spectral power changes or SSVEPs**, linear filters are applied to increase the signal- to- noise ratio of the neuronal source of interest. Such filters can be trained in a supervised (e.g., Common Spatial Pattern - CSP) or unsupervised (e.g., Independent Component Analysis - ICA) manner for each subject individually. ERP features are commonly extracted by averaging the channel wise EEG amplitudes in time intervals that are specified relative to the stimulus. Such intervals can either be predetermined or chosen individually through a heuristic or manual selection. Conversely to feature extraction, pre-processing and classification are very similar in most online BCI systems, with most paradigms being driven by a binary classifier (Blankertz et al., 2008; Krusienski et al., 2008; Blankertz et al., 2011; Wang et al., 2008; Liang and Bougrain, 2012). In order to improve performance of invasive BCIs based on multielectrode arrays (MEAs), optimized Kalman filter approaches (Malik et al., 2011; Gilja et al., 2012; Dangi et al., 2013) have been investigated as well as alternative approaches for feature extraction, such as decoding based on threshold- crossing events, instead of using isolated action potentials (Chestek et al., 2011; Homer et al., 2013).

Possible control signals for BCIs derive from event -related potentials (ERPs) obtained during oddball paradigms (e.g., P300), modulation of spectral power (e.g., sensorimotor rhythms, SMR), brain signals obtained from the visual cortex (VEP, often steady -state visual evoked potentials, (SSVEP), or from single or multiunit recordings.

6.3.2.1 Neurophysiological Signals for Non-invasive EEG-based BCIs

BCI paradigms can be classified into exogenous and endogenous systems, depending on whether or not external stimulation is required (Nicolas-Alonso & Gomez-Gil, 2012) to elicit the neurophysiological signals.

- **Exogenous BCIs** (e.g., based on P300 or SSVEP) rely on brain responses evoked by external stimuli (e.g., visual, auditory or somatosensory stimuli).
- **Endogenous BCIs** depend on brain activity that the users change voluntarily. Such activity does not depend by any external stimuli. Typically, they offer continuous output (such as the use of SMR during imagined movements for cursor control, (e.g., McFarland et al., 2010; Allison et al., 2012a) and can be initiated at will.
- **Hybrid BCIs** combine two or more CNS outputs or classifier results (Pfurtscheller et al., 2010; Müller-Putz et al., 2011; Wolpaw and Wolpaw, 2012).

The non-invasive electrical signals measured by means of the EEG are the most extensively applied in BCI system control. A variety of EEG signals have been used as measures of the brain activity: event-related potentials (ERPs; Farwell & Donchin, 1988; Nijboer et al., 2008; Piccione et al., 2006; Riccio et al., 2011; Sellers & Donchin, 2006), frequency oscillations (sensorimotor rhythms; SMRs; Pfurtscheller et al., 2000; Wolpaw et al., 2000), slow cortical potentials (SCPs; N Birbaumer et al., 1999; Neumann et al., 2003) and steady-state responses (SSRs) (Cheng et al., 2002).

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The Slow Cortical Potentials

WHAT IS IT: The SCPs are slow (in the range of seconds) voltage changes recorded over the sensorimotor cortex, phase- and time-locked to specific sensorimotor events (Kübler et al., 2001). The SCPs typically consist of negative potential shifts that precede actual or imagined movements or other cognitive tasks. Birbaumer and colleagues (1999, 2000) have shown that people can learn to perform mental tasks to produce SCP changes and thereby control the movement of an object on a computer screen. This paradigm was the basis of the implementation of the thought translation device (TTD) which has been tested in people with late-stage amyotrophic lateral sclerosis (ALS), proving that it can supply basic communication capability (Kübler et al., 2001; see example N.1).

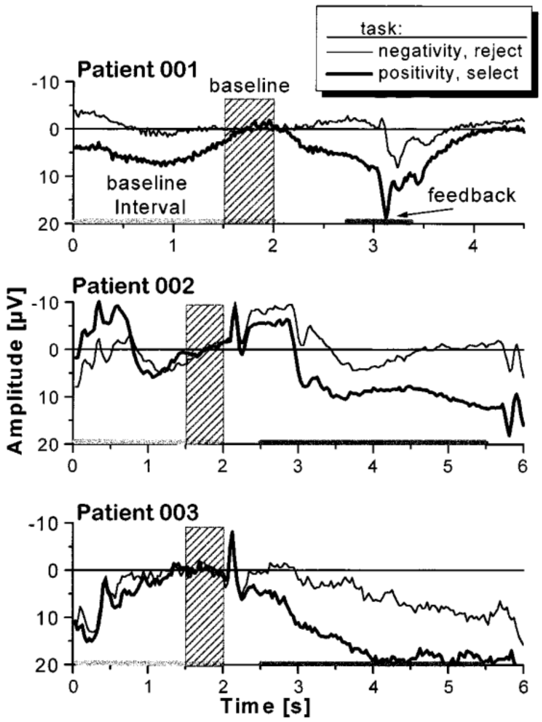

Figure 72: From Birbaumer et al., 2000. An example of Averaged SCPs from patients participating in the study. Selection of a letter was required with a cortical positivity. Representative averages over 700 trials each.

<u>How to control a BCI with SCP</u>:

TTD control requires the user to undergo basic training where she/he learns to control the amplitude of her/his slow cortical potentials by moving the cursor toward the top or bottom of the screen (points are defined by the presence of items e.g., rectangles presented onscreen). Users need to produce cortical negativity or cortical positivity to move the cursor (e.g., upward or downward). Whenever the user succeeds in moving the cursor according to the task requirement positive feedback is given, the corresponding rectangle blinks and a smiling face appears (feedback; Kubler et at., 2001). This means that the user had performed the amplitude shift correctly and that they should try to repeat the successful strategy. Because no optimal strategy exists on self-control

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of slow cortical potentials, and because strategies to move the cursor vary from subject to subject (Roberts et al., 1989) users are not advised on how to influence their amplitude.

Who would benefit of a SCP-based BCI and to do what:

This SCP-based BCI does not require to focus to any external (sensory) stimulation (endogenous BCI). The user can generate the control signal by himself and in asynchronous modality (i.e., any time he wants). Because of this, SCP could be a possible device for target users with sensory impairments (visual or auditory impairments) which would prevent them from attending sensory stimulation. In alternative to cursor movements, the SCP could be used as an ON / OFF switch to control a scanning application.

Steady-State evoked potentials

WHAT IS IT: The steady-state evoked potentials (SSEPs) are stable oscillations in voltage that can be elicited by rapid repetitive stimulation conveyed through visual, auditory and somatosensory modality.

TASK: In the SSVEP-based BCIs (steady state visual evoked potential), stimuli flickering at different frequencies are visually presented to subjects, who direct their attention to one of the stimuli (the one that the user wants to select). The attended stimulus elicits enhanced SSVEP responses at the corresponding frequency, recorded over occipital brain areas (for a review, see Vialatte et al., 2010). This increase in SSVEP amplitude can be detected at the level of single trial, classified and translated into control commands (Liu et al., 2011; Middendorf et al., 2000). Detection of SSPs has been also documented in auditory (auditory steady-state evoked potential (ASSEP); see Plourde 2006 for a review) and somatosensory systems (steady-state-somatosensory evoked potentials (SSSEPS) (Namerow et al., 1974).

How to control a BCI with SSVEP:

To control a SSVEP-based BCI users have to direct their attention to one of the presented stimuli. SSVEP responses are elicited at the corresponding frequency. Each stimulus would represent a (or a group of) letter(s) to select, a directed movement of a cursor or any other device command.

Who would benefit of a SSVEP-based BCI and to do what:

To use SSVEP-based BCI, the user must be able to gaze at and perceive the stimulation source. Selections between items can be done very quickly, but the number of items, flashing at different frequencies, is limited (max 10 or 12). This BCI could be helpful for people with severe motor disabilities; a reduced number of stimuli would make the task more intuitive and easier, requiring a limited cognitive involvement. It allows to select an item between a set of options, then it can be used for basic communication or for environmental control applications.

Event Related Potentials

WHAT IS IT: The ERPs, embedded within the EEG background activity, are manifestations of neural activity that is triggered by, and involved in the processing of specific events. The ERP-based BCIs are implemented with an oddball paradigm, wherein a rare target (oddball event) is intersected with frequent non-target events. These BCIs usually exploit an endogenous ERP, known as P300, as input signal. The P300 is a positive deflection that occurs in the scalp recorded EEG approximately 300 ms after the presentation of the rare visual, auditory or somatosensory—task relevant—

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stimulus (Sutton et al., 1965). By focusing attention on the rare target (e.g., by keeping a mental count of its occurrence), the P300 amplitude can be increased and therefore its detection and classification improves.

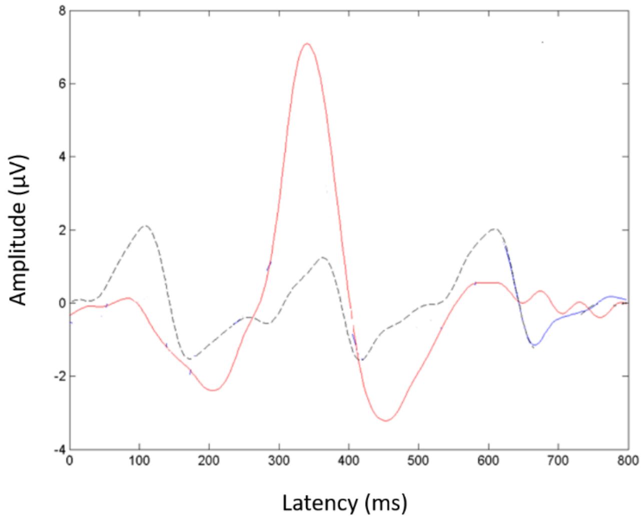

Figure 73: A P300 event related potential, average of epochs related to target stimuli (red) and non-target stimuli (black dotted line)

<u>How to control a BCI with the P300:</u>

In a P300-based BCI, user is provided with sets of external target and non-target stimuli. Stimuli may be presented in different sensory modalities: visual, auditory, tactile. The user is instructed to attend to the target stimulus and to mentally count how many times it occurs and to ignore other stimuli. The counting task is necessary to keep the attention focused on the target stimulus. There are two main phases in a P300-based BCI, defined as “**calibration mode**” and **“online mode**”. The task that the user has to perform is the same in both phases, that is, to focus attention on target stimulus. The main difference between the two phases is that during the “calibration mode” no feedback is provided, whereas in the “online mode” the counting task results in feedback (target selection) at the end of a set of stimuli. “Calibration mode” may be also defined as training session, since it is necessary to collect data about user’s neurophysiological response to target presentation. These data are necessary to create a classifier used in the “online mode”; this allows the user to have feedback (target selection) at the end of the presentation of a set of stimuli.

Visual modality is usually associated with a matrix of stimuli flashing in a random way and the user has to count the times that the target stimulus is intensified (Farwell & Donchin, 1988). Auditory modality is characterized by the presentation of auditory stimuli differing in at least one characteristic (e.g., intensity, location). The user has to count how many times the target stimulus occurs. In this case, auditory target stimulus may be the mean to select a visual target on a communication device (e.g., a speller matrix; Furdea et al., 2009; Schreuder et al., 2013) or it can be a communication itself (e.g., select auditory stimuli YES/NO as answers to questions; Sellers & Donchin, 2006). Finally, somatosensory stimuli are usually associated to multiple vibrotactile stimulations conveyed in different parts of the body. The user has to attend the target stimulus

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located in a specific area of the body and to count how many times it occurs (Brouwer and van Erp, 2010).

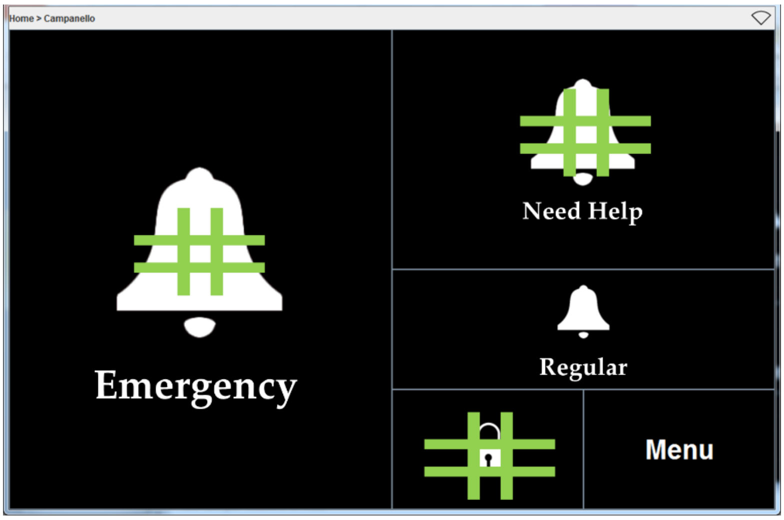

Figure 74: An example of a user interface for a P300-based BCI. Green grid stimuli are overlapped to items on the screen.

<u>Who would benefit of a ERPs-based BCI and to do what:</u>

P300-based BCIs rely on different stimulation modalities, so in case of sensory impairment, the stimulation can exploit one of the other intact sensory channels. The largest number of applications presented in the literature concerns visual stimulation. Based on interface organization P300-based BCI could work regardless of whether the user gazes or not at the target stimuli: in some conditions it could be used even in case of eye movements disorders (e.g., nystagmus). On the other hand, cognitive diseases (e.g., selective attention; Riccio et al., 2018) could affect performance. Target users are people with severe motor diseases. Main applications focus on communication (spelling, text2speech application, etc) and environmental control (domotics, web Browsing, etc.).

Sensorimotor Rhythms

The BCIs based on sensorimotor rhythms (SMRs) are operated by voluntary modulation of such rhythms recorded over scalp sensorimotor areas, within a frequency range of 8 to 30 Hz (mu and beta band). The SMRs have a longstanding history related to motor behaviour (Berger 1930(G Pfurtscheller & Aranibar, 1979; Pfurtscheller & Neuper, 1992; Jasper and Andrew 1938, Jasper and Penfield 1949). In fact, it has been repeatedly shown that the execution or imagination of limb movements induces changes in this rhythmic activity. (Pfurtscheller & Aranibar, 1979; Pfurtscheller & Neuper, 1992. Pfurtscheller and Aranibar (1979) and Pfurtscheller and Neuper (1992) have further elucidated this phenomenon and demonstrated that SMRs decrease and/or increase during motor behaviour (event-related desynchronization, ERD, and event-related synchronization, ERS).

How to control a BCI with the Sensorimotor Rhythms:

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BCIs that are based on sensorimotor rhythms (SMRs) are operated by voluntary modulation of rhythms that are recorded over sensorimotor areas related to limb movement execution and imagination (Pfurtscheller & Neuper, 1992). In brief, motor imagery induces a desynchronization (i.e., a reduction in spectral power) that occurs within specific EEG frequency ranges (alpha 8–12 Hz and beta 18–26 Hz), above sensorimotor cortical regions contralateral to the imagined part of the body (Pfurtscheller & Lopes da Silva, 1999). The consequent modulation of SMRs of (at list) two brain states associated a) with two types of motor imagery, [e.g., *1)* imagine moving the right-hand vs imagine to move the left hand and *2)* imagine to move the right-hand vs imagine to move both feet] or b) with one type of motor imagery and relaxation: [e.g., imagine to grasp both hands vs relaxation].

The classification of such modulations is, therefore, translated in device commands (cursor movement, item selection etc.).

<u>Who would benefit of a SMR-based BCI and to do what</u>:

SMR-based BCIs do not require external stimulation; the user can generate the control signal by himself and in asynchronous modality. The feedback provided to the user allows them to learn the control of SMR-based BCIs; training sessions are usually required to achieve good control accuracy. Potential users can be people with motor disability; feedback can be provided throughout any modality (visual, tactile, auditory) in case of sensory impairment. SMR-based BCIs can be used to control a cursor on a screen, as a switch or to control a neuroprostesis (for motor rehabilitation).

BOX 2
BCI CONTROL

EXAMPLE 1: <u>SCP for a virtual speller in people suffering from Amyotrophic Lateral Sclerosis (A Kübler et al., 2001)</u>
This example describes two people suffering from ALS. Patient 1 (male; age, 45yr) had a severe tetraparesis and no ability to speak. Eye muscles were still under voluntary control and training was conducted at the patient's home, 2 to 3 days weekly. Patient 2 (male; age, 31yr) was almost completely paralyzed and dependent on invasive artificial ventilation via tracheostomy. Eye movement were still under voluntary control. Training was conducted at the patients' home, 3 days weekly for 3 weeks and then 3 days within the same week once a month. Slow cortical potentials were recorded with Ag/AgCl electrodes from the vertex (Cz, international 10–20 system). End-users were able to select letters that were presented dichotomously: the alphabet was gradually split into two subsets of letters, successively presented in five levels, until the single intended letter was presented for selection.

EXAMPLE 2: <u>SMR to control a virtual keyboard</u>
The modulation of EEG sensorimotor rhythms (SMRs) associated with motor imagery tasks can be exploited to control a cursor in patients with SCIs (McFarland et al., 2008; Jonathan. Wolpaw & McFarland, 2004) and ALS (Kübler et al., 2005). Furthermore, SMR modulations could be exploited to control a virtual keyboard (Neuper et al., 2006),

EXAMPLE 3: <u>SMR to environmental control</u>
SMR modulation can be exploited for applications of environmental control (Cincotti et al., 2008) in people with motor disabilities due to progressive neurodegenerative disorders.

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EXAMPLE 4: P300 to control a virtual keyboard

Brain-computer interface (BCI) evaluation in people with amyotrophic lateral sclerosis (McCane et al., 2015). Twenty-five patients suffering from Amyotrophic Lateral Scleroris (ALS) were recruited (mean ± SD: 55.8 ± 8.6); the mean ALS Functional Rating Scale-Revised score (ALSFRS-R; Cedarbaum et al., 1999) was 6.2 (±8.2).

The users were shown a 6x6 matrix containing 36 items (English characters and numbers) and a visual oddball paradigm. The evaluation consisted of nine runs, each one representing a word to spell. For each trial, patients were asked to attend to the target character and to count how many times it was intensified. EEG was acquired with a 16-channel electrode cap (expanded 10-20 system).

Seventeen end users had accuracies above 70% and 8 subjects had accuracies below 40%. The accuracies of the first group were high enough to support communication. No significant correlation was found with ALSFRS-R scores.

6.3.3 OUTPUT: Brain-Computer Interface Applications

6.3.3.1 Communication and Environmental Control

Brain disorders or neuromuscular diseases can lead to severe and complex impairments of **communication and interaction abilities,** which could lead to social isolation and dependency, with a drastic impact at an individual, family and society level, thus affecting health, wellness and quality of life (QoL). Due to the evolution of communication means (PCs, smartphones, tablets) and to the widespread availability of a large number of online services (social networks, internet banking, public administration services, eHealth, remote work and education, etc.), the concept of communication is no longer limited to verbal interaction, but also includes the accessibility to digital technologies.

Assistive Technology (AT) is "an umbrella term indicating any product or technology-based service that enables people of all ages with activity limitations in their daily life, education, work or leisure" (Andrich et al., 2013). The definition includes both "mainstream" technologies (general-purpose technologies) and "assistive" technologies (purposely designed for people with disabilities), whose assembly varies case-by-case, depending on the individual characteristics, the activities that the person is intending to perform, and the physical and human context where he/she lives (Andrich et al., 2013). Current ATs provide a powerful array of communication, information, organization, and social networking options for individuals with complex communication needs (Abbott et al., 2014). They foster participation, inclusion, choice, control, self-determination and autonomy for people with disabilities (International Classification of Functioning, Disability, and Health: ICF, 2001; see session 1.2.2), alleviating dependency and empowering them for effective participation in the society. Nowadays, technological innovation has paved the way for the development of increasingly powerful individualized ATs to meet the needs of people with disabilities. Within the technology advancement, the BCI technology can provide communication and interaction support and render personal AT solutions fully inclusive. Currently, there are substantial evidence that BCI can provide people with severe communication and motor disorders with an AT to eventually restore their interaction with the environment (Riccio et al., 2015; Schettini et al., 2015). A significant number of studies demonstrated that EEG based-BCI could establish communication in, and facilitate daily life

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activities of people with communication and interaction disabilities (Holz et al., 2015; Wolpaw et al., 2018), due to neurological disorders, such as neurodegenerative diseases (amyotrophic lateral sclerosis – ALS, Spinal muscular atrophy – SMA), spinal cord injury (SCI) and acquired brain injury (ABI) (Figure 75).

Figure 75: An example of a P300-based BCI setup

End-users of BCIs for communication and interaction

In recent years, the development of BCI-based communication systems has relied on the UCD principles (See session 1.1.5; Kübler et al., 2014; Millán et al., 2010; Powers et al., 2015), in which end-users were the focus of the development of BCIs and the UCD iterative process was adopted.

- *Primary users (end-users)* of BCIs for communication and environmental interaction are people with functional deficits affecting their capacity to communicate and interact with the environment; individuals who suffer from amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), cerebral palsy (CP), brain stem stroke, spinal cord injury (SCI), muscular dystrophy, Duchenne muscular dystrophy (DMD), Rett syndrome, peripheral neuropathy, and locked-in syndrome (LIS) might benefit from BCIs. The extent of end-users' residual neuromuscular control, in addition to the etiology of their pathology, has been considered to be the main factor in categorizing them for BCI applications. However, in the past several years, the importance of end-users' cognitive abilities in their interaction with BCI paradigms has been noted (Nijboer, 2015; Riccio et al., 2013, 2018; Schreuder et al., 2013).
- *Secondary users* are nonprofessional users who would be influenced indirectly by BCI use, such as family members, caregivers, and people who interact with end-users.
- *Tertiary users* are professional users, such as manufacturers, AT professionals, researchers, and other stakeholders, e.g., insurance firms and public health systems.

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Studies adherence to the UCD approach, primarily involve potential end-users as testers of BCI technology and include evaluations on usability: assessments of effectiveness, efficiency, and user satisfaction (*ISO 9241-210:2010 - Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems*).

Restore communication and control

People with advanced ALS (leading to a different range of motor diseases) participated in the first studies evaluating the feasibility of BCIs for communication. They were trained to control a virtual speller with slow cortical potentials (SCPs) (Birbaumer et al., 1999, 2000; Hinterberger et al., 2003; Kübler et al., 2001; Neumann et al., 2003). Furthermore, BCIs based on sensorimotor rhythms (SMRs) operated by voluntary modulation of rhythms were used to control a virtual speller (Neuper et al., 2006), for environmental control (Cincotti et al., 2008), and assistive mobility applications (Leeb et al., 2013) in people with motor disabilities.

Studies aimed at evaluating BCIs for communication involving potential end-users were also (and mostly) focused on P3-based BCIs (P3-BCIs). The first P3 paradigm comprised a virtual keyboard visually presented, that was organized in a 6by6 matrix (Farwell & Donchin, 1988); with such protocol people with ALS could communicate through the P3-BCI (Birbaumer, 2006; McCane et al., 2015), maintaining stable performance over time (Nijboer et al., 2008; Silvoni et al., 2013), with approximately the 30% of the population with no adequate control (McCane et al., 2014). Furthermore, the characteristics of the stimulation eliciting the P3 (Kaufmann et al., 2013; Townsend et al., 2010), the user's motivation (Nijboer et al., 2010), and the selective attention (Riccio et al., 2013, 2018) were shown to influence the BCI performance of people with neurodegenerative diseases.

Impairments to oculomotor control and visual function can affect the performance of BCIs that rely on visual abilities. Indeed, it was emphasized the needs of eye gaze-independent BCIs (Riccio et al., 2012), exploiting visual, auditory, and tactile channels (Acqualagna & Blankertz, 2011; Aloise et al., 2013; Höhne et al., 2011; Schreuder et al., 2013). It was demonstrated that users suffering from ALS were able to control a cursor on interfaces based on covert attention (no need to gaze the target to pay attention; Marchetti et al., 2013). In parallel, visual eye gaze-independent BCIs which exploited steady-state visual evoked potentials (SSVEP) were proposed (Zhang et al., 2010).

Auditory BCIs have been evaluated by participants with motor disabilities: some studies report a successful control (Kleih et al., 2015; Sellers & Donchin, 2006) differently from others, which described unsuccessful clinical trials (Kübler et al., 2009; Schreuder et al., 2013; Simon et al., 2015). These differences were attributed to the excessive cognitive workload that was required to control the BCIs with multiclass paradigms, underscoring the need to develop BCIs that are adaptable to various end-users and cope with user needs in accordance with the UCD approach. In particular, in Schreuder et al. (2013), the participant, who had suffered from an ischemic brain stem stroke, was presented with an auditory and a visual ERP paradigm, only the latter of which she successfully controlled, possibly due to her neuropsychological characteristic.

The relevance of adapting BCIs individually in accordance with the UCD principle was also highlighted in a case study by Kaufmann et al. (2013). With a Locked-in participant, tactually evoked ERP modality was more reliable than visual and auditory modality. Again, this discrepancy showed the need to identify the best stimulus modality for each end-user. In an effort to bring the BCIs outside the laboratory, initial steps were made toward the integration of BCI-based systems with existing technologies following a UCD approach.

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Brain-computer interface as an assistive technology

Despite the relatively high number of scientific studies showing that BCIs could enable people with communication disorders and therefore improve the inclusiveness of AT solutions, BCI systems are rarely available in the portfolio of AT centres for full deployment to end-users. This translational gap is probably due to bulky equipment, long set-up times, a lack of reliability, and missing integration with other AT (Müller-Putz et al., 2011). One of the current main focuses of BCI research is to bridge this translational gap between BCI development and end-users and to eventually turn the BCI into an assistive device and to incorporate BCI technology in the AT centres’ everyday practice. This translational step is required to deploy BCI-based communication and interaction solutions to end-users and provide them with access to up-to-date digital communication and interaction (For more details about social networks please refer to unit 3, topic 1).

Recent technological development in the design of BCIs for communication has resulted in a ‘hybrid’ BCI-based communication device (Müller-Putz et al., 2011) which exploits brain signals (EEG) and electromyographic signals (EMG) derived from residual muscular activity of end-users (Riccio et al., 2015). The end-users would be able to switch to the BCI channel when the muscular channel is fatigued or weak; alternatively, he/she will use them as complementary channels, thus leading to a remarkable increase in the usability of BCI systems. The UCD approach (ISO 9241-210, 2010) consists of an iterative process in which the understanding and specification of user needs, in a given context of use, precedes the evaluation of the proposed system against the defined requirements. The iterative process to release a user-adapted product comprises three main stages: (i) specify the user requirements, (ii) produce design solutions to meet these requirements, and (iii) evaluate the designs against the requirements (session1.3.1). The growing multidisciplinary facet of the BCI research community has led to the integration of the UCD principles in design and evaluation processes of ‘usable’ BCI systems. This integration implies a comprehensive understanding by the BCI researcher of the wide range of users who participate in the development of a BCI system as well as the interaction with health professionals, medical companies, caregivers, and patients with specific deficits and impairments that are related to their medical condition (Riccio et al., 2016).

BOX 3
USABILITY EVALUATION

BCI performance is evaluated in the domain of usability, which consists of three core constructs: effectiveness, efficiency, satisfaction (Nielsen, 1995).

- *Effectiveness* is defined as the accuracy and completeness with which users achieve goals while using the BCI.
    - Measures of effectiveness: the <u>task accuracy</u>, defined as the ratio between the number of correct selections and the <u>total number of selections</u> required to complete a task with BCI.
- *Efficiency* describes the degree to which BCI enables quick, effective and economic performance, in terms of device performance and user workload perceived while using the system.
    - Measures of efficiency: <u>Information Transfer Rate</u> (ITR; bit/min. Wolpaw et al., 2000), <u>time per correct selection</u> and <u>National Aeronautics and Space Administration-Task Load Index</u> (NASA-tlx; Hart, 2006). ITR is defined as the amount of information communicated per unit of time (Wolpaw et al., 2002); time per correct selection is the ratio between total time to complete a task with

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BCI and number of correct selections. NASA-tlx is a multidimensional questionnaire that evaluates the overall workload (0-100) perceived during the usage of BCI; the overall workload is a weighted average derived from the contribution of six factors: mental demand, physical demand, temporal demand, performance, effort, frustration. • <u>Satisfaction</u> represents the degree to which users are satisfied during the usage of BCI. o User satisfaction is usually assessed through the administration of questionnaires and scales. Frequent measures of satisfaction are System Usability Scale (SUS, 0-100; (Bangor et al., 2008), a Likert scale that evaluates user satisfaction about a technological device, and the Visual Analogue Scale (VAS, 1-10; Ohnhaus et al., 1975), a visual method to assess feelings and satisfaction while using a technological device.

6.3.3.2 Rehabilitation

BCI offers the possibility to detect, monitor, and reinforce specific brain activities. In medical conditions affecting the CNS, brain activity can be altered, paralleling the impairment of the specific related function. The potential to guide altered brain activity back to a physiological condition through BCI and the assumption that this recovery of brain activity leads to restoration of behaviour -i.e., function (McFarland et al., 2015) constitute one of the rationales behind the use of BCI systems in rehabilitation. BCI technology can, indeed, be used as a rehabilitative intervention, besides other neuromodulation (e.g., non-invasive brain stimulation) and neurofeedback paradigms.

Motor Rehabilitation

Most current work on BCIs in neurorehabilitation is targeted toward improving motor deficits due to stroke. Applications for motor rehabilitation are based on two mechanisms:

- Brain to function: to modify brain activity to consequently improve motor behaviour (Pichiorri et al., 2015; Prasad et al., 2010)
- Brain to limb: to use brain activity to control devices that assist movement (e.g., robotic orthosis, peripheral stimulation devices). This would improve the quality of movement and re-establish the connection between the brain and periphery (i.e., limb) and consequently improve motor function (Buch et al., 2008).

The two approaches can also be combined to fully realise the potential of BCI (Ramos-Murguialday et al., 2013) being that their mutual interaction is desirable; the "perfect blend" of these components should be adjusted to address each specific medical condition, or even each specific patient at the specific time when the BCI intervention is applied to target optimal motor recovery.

The initial reports on the use of BCIs systems in motor rehabilitation after stroke were case reports (Daly et al., 2009) or small group studies (Buch et al., 2008). These studies delineated the fundamental approaches and highlighted several important aspects:

- the possibility to modulate brain activity in response to training (Buch et al., 2008);
- the possibility of obtaining functionally relevant achievements even in a chronic, severely impaired patient (Daly et al., 2009);
- the advantages of combining BCIs with physical therapy to obtain further benefits (Broetz et al., 2010).

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More recent studies have tested specific BCI approaches in randomized controlled trials to demonstrate the benefits of the BCI intervention. Positive results have been shown for upper limb motor recovery in the chronic (Ramos-Murguialday et al., 2013) and subacute phase (Pichiorri et al., 2015) and for approaches that target lower limb recovery (Mrachacz-Kersting et al., 2015).

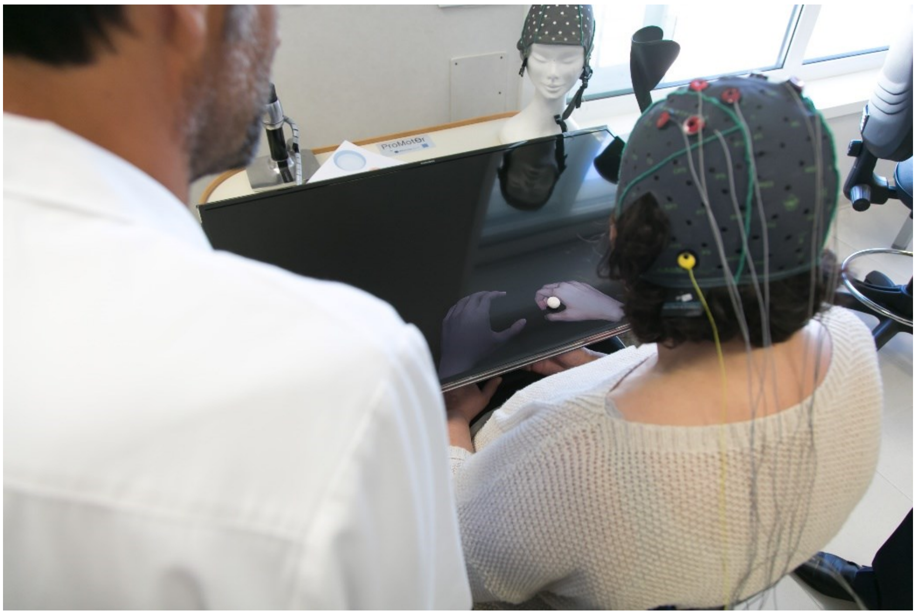

Figure 76: SMR-based BCI for upper limb rehabilitation after stroke

Some important aspects induce plasticity and thus improve motor recovery:

- contingency between the mental task and the feedback that is provided by the BCI system;
- combination of BCI approaches and standard therapies as to foster a priming effect of the BCI and put the brain in the optimal condition to boost the functional gains that are obtained with physical therapy (Naros & Gharabaghi, 2015; Ramos-Murguialday et al., 2013);
- Only the brain activity that is related to the targeted function must be reinforced in the BCI paradigm by selecting physiologically relevant features for BCI control patients.

Cognitive Rehabilitation

Current cognitive rehabilitation refers to a set of interventions that aim to improve a person's ability to perform cognitive tasks by training previously learned skills and teaching compensatory strategies (Milewski-Lopez et al., 2014; Zucchella et al., 2014). The positive effects of this approach were demonstrated in a longitudinal PET and fMRI study, in which a standardized behavioural training programme of alertness resulted in changes in functional activity in brain areas related to the specific trained function (Sturm et al., 2004). However, the cognitive enhancement that is affected by such techniques is limited to the specific behavioural exercise, and patients encounter difficulties in generalizing the benefits to daily life situations (Owen et al., 2010).

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Several EEG neurofeedback studies have shown that a range of cognitive functions might be enhanced using this approach (for a review, see Gruzelier & Egner, 2005). Applications have included cognitive abilities such as attention (Egner & Gruzelier, 2004), working memory (Hoedlmoser et al., 2008).

Training persons to increase negative SCP shifts improves basic attentional performance and enables individuals to focus on tasks, inhibiting the processing of internal or external distractors. Instead, providing feedback of specific EEG frequency bands, such as upper alpha, theta, and beta, enhances the performance of specific cognitive functions, such as encoding and retrieving new material from memory, sustaining attention, and inhibiting actions (for a review, see Gruzelier, 2014a, b,c).

Preliminary clinical evidence of exploiting neurofeedback as an intervention to improve cognitive functioning are available in neurologic disorders such as stroke. Cho and colleagues (Cho et al., 2015) have conducted a clinical study on 42 stroke patients who were randomly assigned to either an EEG neurofeedback (b-SMR training mode) or computer-assisted cognitive training (attention, concentration, and memory programmes) or control condition (i.e., conventional rehabilitation training). Changes in the brain activity (ratio of b oscillation) were observed only in the neurofeedback group that also showed an improvement in cognitive performance. Similar findings of a positive effect on memory function were replicated in single-case reports (Kober et al., 2017).

6.4: Passive BCI

BCI includes systems that can passively decode mental, emotional, and cognitive states from the neurophysiological signals of the user; such a system has been defined as "passive BCI" (pBCI; Zander et al., 2009). A passive BCI detects metal states of the user, automatically induced while interacting with the surrounding environment, and it is not required any active modulation of user's brain activity or engagement in a specific task, as in the active/reactive BCI (Zander et al., 2009). A passive BCI is not only a system monitoring cognitive user's state, since the information detected by the BCI is automatically interpreted with the aim of improving the human-machine interaction (Zander and Kothe, 2011). In this regard, pBCI can be used with 3 main purposes: i) to provide feedback to the user, ii) to modify the behaviour of the system itself that the user is interacting with, iii) to provide information about the user's mental state without relying on verbal communication (Borghini et al., 2020).

As for the active BCI, many devices may be used to record brain activity and implement a BCI: electroencephalography (EEG) and magnetoencephalography (MEG), functional-near infrared spectroscopy (fNIRS), and functional magnetic resonance (fMRI). Since a pBCI aims at monitoring mental states during every-day and working activities, a portable, comfortable and easy-to-use system is necessary; in this regard, EEG is the most feasible device. Furthermore, other biosignals (EOG, ECG, GSR and eye movements) can be used in association with neuroimaging techniques to monitor mental states, since they correlate with some mental states, such as stress or drowsiness (Borghini et al., 2014, 2020).

One of the main applications of pBCI is the evaluation of user's mental states in high-demanding environments, where the user is subjected to multiple sources of information, attention is divided between different stimuli and mistakes can cause serious consequences. Among these contexts, pBCI has been applied to evaluate mental states in the driving and aviation field, in air traffic

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management as well as in scenarios characterised by high-demanding workload and stress (i.e., working activity of professional surgeons). Furthermore, pBCI can be employed to evaluate the cognitive demand of different technologies as well as to evaluate team performance and resources. Finally, pBCI has also a more commercial application specifically in the field of gaming and neuromarketing (see Aricò et al., 2018 for a review about pBCI applications).

6.5: Conclusion

BCIs allow people to act on the environment in absence of neuromuscular activity, throughout instant interpretation of the changes in the brain activity that are voluntarily induced by the subject (Wolpaw et al., 2002). The Assistive Technology field is rapidly evolving parallel to the evolution of digital technologies and the widespread services and communication means available on the internet. BCIs represent a promising innovative technology with the potential to support highly individualized AT tools to assist end-users with a mutual rendering of BCIs and AT solutions that are fully inclusive. BCI research is currently focused on turning BCI into an AT input device for full integration into AT centres’ portfolios. Besides their role in assisting the return to everyday life of people with persistent communication/interaction impairment, BCI also have the full potential to support neurorehabilitation. As compared to other strategies aiming to favour brain reorganization (e.g., NIBS) or to stimulate the periphery (e.g., FES or robotics devices), BCIs have the potential to combine these two aspects and to interact with other technologies.

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Summary:

This unit showed the potentials that new digital technologies can have in supporting people with physical and mental disabilities and functional limitations:

Assistive Technologies and Aids can help people to carry out activities independently and participate in society, which they would otherwise not be able to.

Smart Home applications support independent and safe living in old age, but also especially with speech control for immobile or blind people.

Robotic is becoming an increasing field to support rehabilitation, people in their home environment and health professionals.

Within the context of teaching social communication and functional living skills, **Virtual Reality and Augmented Reality** can provide unique benefits and advantages to support learning.

Brain-Computer Interface could establish communication in and facilitate daily life activities of people with communication and interaction disabilities, due to neurological disorders. Furthermore, BCI can be used for rehabilitation (motor or cognitive) goals.

However, all these new technologies are also associated with ethical decisions and factors concerning protection of personality and data. These need to be addressed, as do sustainability aspects.

It is essential to train, inform and assist users (clients and professionals), so that they can make informed decisions and use the full potential of these technologies.

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Learning Evaluation:

A. Self-Assessment Questions:

Question 1 – Which description of disability refers to the International Classification of Functioning, Disability and Health (ICF)?

a. Disability refers to the interaction between individuals with a health condition and personal and environmental factors.
b. Disability is directly caused by disease, trauma or other health condition.
c. Disability means to be excluded from many areas of society.
d. Disability is a complex collection of conditions, many created by the social environment.
e. Disability means that a person is not able to participate in work.

Question 2 – What is the difference between the terms "Assistive Technology" and "Assistive Product"?

a. They can be used synonymously.
b. The term Assistive Technology is more common in the EU, while Assistive Product is more common in the US.
c. Assistive Technology refers also to systems and services, not only to devices.
d. The use of each of these terms depends on the grade of accessibility.
e. Assistive products have an ISO classification.

Question 3 – Which of the following statements is wrong?

a. People with deafness or hearing loss benefit from messenger services in written language.
b. Exoskeletons are not good to train walking.
c. A high colour contrast on websites and in apps is important for people with vision impairments.
d. Communication aids can also be controlled with eye movements.
e. Digital day planners with voice output (e.g., on a smartphone) can help people with intellectual disabilities to structure their day.

Question 4 – On which aspect regarding Smart Homes does AAL <u>not</u> particularly focus?

a. Environmental control.
b. Health monitoring.
c. Daytime organisation.
d. Fall detection.
e. Plant watering.

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Question 5 – Which statement is wrong? Smart home technology…

a. connects devices via “the Internet of Things” (IoT).
b. can help people to stay longer in their familiar surroundings.
c. has improved telecare processes and monitoring of accidents at home.
d. is usually operated via remote control.
e. can integrate robotic devices.

Question 6 – Which smart devices can help people with specific disabilities or functional declines to control their daily life?

a. Immobility: Smart speaker
b. Cognitive decline: Medication reminder system
c. Hearing loss: Smart speaker
d. Vision impairment: Electronic bed
e. a and b are correct

Question 7 – Which statement on robotic systems is wrong?

a. Rehabilitation robotic can support intensive therapy and increase motivation.
b. Practical experience reduces willingness to interact with a robot.
c. Robotic arms can enable people with paraplegia to eat independently.
d. Many robotic solutions, especially complex assistive robots, are still primarily research platforms.
e. Housework is a task that many people would like to have carried out by robots.

Question 8 – Exoskeletons…

a. are implanted skeletons with servomotors to support mobility.
b. can be controlled via haptic interfaces.
c. can be controlled via sensor-based interfaces.
d. a and b are correct.
e. b and c are correct.

Question 9 – Which considerations are appropriate when implementing robotic systems in nursing care or at home?

a. Physical barriers do not need to be taken into account, as robots can usually overcome stairs and hurdles.
b. The use of robots is harmless in terms of legal uncertainty.
c. The feeling of safety is essential for users of robotic systems.
d. No additional measures are required with regard to employees.
e. None of the above.

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Question 10 – The power consumption of a sensor depends on…

a. the hardware of the sensor (different components we need).
b. the size of the sensor.
c. the firmware of the sensor (what we ask the sensor to do).
d. both the hardware and the firmware.
e. none of the above.

Question 11 – Why is the power consumption of a sensor an important matter?

a. Because the consumption of a sensor can be extremely high.
b. Because sensors consume batteries and batteries have an environmental cost.
c. Because they consume electricity around the clock, even in standby mode.
d. Because they can be used in people's homes.
e. Because the number of sensors installed increases dramatically every day and the total consumption is high, even if the consumption per unit is low.

Question 12 – What does the term "Duty Cycling" mean for a sensor?

a. That the sensor is made of recycling materials.
b. That the sensor is using different wireless communication protocols.
c. That the sensor is not sending data unless some other device requests for these data.
d. That the sensor has the duty to send data when it is on.
e. That the sensor's communication modules fall in sleep mode when they don't send data.

Question 13 – Which of the following is <u>not</u> an advantage of using VR or AR to teach social communication skills?

a. VR and AR are cheap and accessible.
b. Evidence based teaching strategies can be combined with VR and AR to teach these skills.
c. Multiple learning opportunities can happen in a *socially safe* environment.
d. VR and AR can support generalization of these skills across contexts.
e. The learning environment and supports can be tailored to the individual.

Question 14 – Which of the following is <u>not</u> one of the main components of VR equipment?

a. Controllers
b. Helmet
c. Sensors
d. Haptic gloves
e. Headphones

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Question 15 – Which of the following is not a factor that contributes to cybersickness?

a. Focusing on stationary objects
b. Realism
c. Irregular movement
d. High Acceleration
e. Focusing on moving objects

Question 16 – A BCI can…

a. control an external device by using ocular movements.
b. control an external device by reading your minds.
c. translate a predefined brain activity in a control signal.
d. send message using speech recognition.
e. None of the above is correct.

Question 17 – Which of the following is an invasive method to measure brain activity?

a. Electroencephalography (EEG)
b. Electrocorticography (ECoG)
c. Magnetoencephalography (MEG)
d. Functional near infrared spectroscopy (fNIRS)
e. Functional magnetic resonance imaging (fMRI)

Question 18 – Which of the following statements is false?

a. To elicit a P300, potential stimuli may be presented in different sensory modalities: visual, auditory, tactile Electrocorticography.
b. P300-based BCI user is provided with sets of external target and non-target stimuli.
c. P300 is a positive deflection that occurs approximately 300 ms after the presentation of the rare stimulus.
d. A P300-based BCI requires a calibration.
e. In a P300-based BCI, the stimuli flicker at different frequencies.

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B. Activities:

Activity 1 – ICF

- Describe the effect of environmental and personal factors on activities and participation.
- Find another example in which external factors can contribute to diminishing a persons' disability by reducing activity limitations and participation restrictions.

Activity 2 – Web Content Accessibility Guidelines

- Visit WCAG (https://www.w3.org/WAI/WCAG21/quickref/) or find a translation in your language and identify three guidelines that will help people with a visual impairment.
- Use the free online tool WAVE (https://wave.webaim.org/) to check a website on accessibility of your choice.

Activity 3 – Application of MEESTAR

- Discuss the ethical dimensions (seven ethical values and three perspectives) of MEESTAR for a specific assistive device.
- Are there additional aspects to be considered?
- Discuss to what extend this influences the life of your clients and the work you do.

Activity 4 – VR and AR

- Reflect upon the knowledge acquired on VR, AR, and MR.
- Consider the advantages of VR and AR for the individuals you support and how you would discuss these with your clients' family members and your colleagues.
- Outline considerations that would be important to highlight within this discussion.

Activity 5 – Brain-Computer Interface

- Describe a potential user of a P300-based BCI for communication and control: which are, in your opinion, the main factors to take into account?
- Try to compare Brain-Computer Interface to other high tech assistive technologies: what are the main BCI's strengths and weaknesses?

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Additional activity:

- Describe a scenario with a specific technical aid in which you show aspects that influence acceptance with the assistance of the TAM2 Model.
- In which way could elderly people be encouraged to use smart home devices?

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UNIT 2: Self-Advocacy and Technology Acceptance

Aim:

The aim of this Unit is to provide clear and useful information about the concept and the practice of self-advocacy. The Unit includes definitions and information about self-advocacy and core related skills, in order to provide people working in the care of persons with intellectual disabilities with relevant knowledge, suggestions and modalities, allowing them to help these persons develop their potential skills and attitudes and become self-advocates.

This information should be easily transferrable and applicable into the everyday life of people working in the care and assistance of people with intellectual disabilities, caregivers and supported living operators, avoiding to overload them with notions and theories that not only sometimes go well beyond the scope of the project, but can be even in conflict with each other. Therefore, this Unit explains the concept of self-advocacy and the related techniques with particular attention to practical training.

Learning Outcomes:

After completing the course, the learner will be in a position to:

In terms of **knowledge:**

- ✓ Define self-advocacy.
- ✓ Define the core components of self-advocacy.
- ✓ List the main outcomes of self-advocacy.
- ✓ Explain self-advocacy to people, including people with intellectual disabilities.
- ✓ Illustrate the main components of self-advocacy to people, including people with intellectual disabilities.
- ✓ List and compare technological resources useful to self-advocacy activities.

In terms of **skills:**

- ✓ Take part in self-advocacy initiatives.
- ✓ Develop self-advocacy related activities.
- ✓ Apply the knowledge acquired to particular contexts.
- ✓ Identify realistic individual and group’s goals.
- ✓ Choose some technological resources to be used in self-advocacy training.

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In terms of **attitudes:**

- ✓ Choose to be open to people with disabilities needs, wishes, expectations and hopes.
- ✓ Develop awareness of the need to set realistic goals.
- ✓ Support people with intellectual disabilities in their path towards self-determination.
- ✓ Design self-advocacy activities and role-playing scenarios.
- ✓ Assess the pros and cons of some technological resources in training.

Topics:

- What Self-Advocacy Is
- Self-Awareness
- Communication
- Rights
- Use of Augmented Reality in Self-Advocacy Training
- Technology Acceptance
- Self-Advocacy Scenarios

Key Words:

• Self-advocacy	• Communication
• Self-awareness	• Assertiveness
• Self-determination	• Leadership
• Choice making	• Rights
• Problem solving	• Augmented reality
• Training	• Role-playing
• People with intellectual disabilities	• Simulation
• Autonomy	• Accessible information
• Needs	• Independence
	• Responsibility

Introduction:

Self-advocacy is an important issue in the lives of all people. From both an ethical and practical point of view, self-advocacy is important for everyone and all people need to acquire skills enabling self-advocacy.

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This Unit aims to provide definitions and information about self-advocacy and its core skills, in order to provide people working in the care of people with intellectual disabilities with relevant knowledge, allowing them to help service users develop their potential skills and attitudes and become self-advocates.

The Unit addresses both research findings, and additionally provides practical examples and exercises, since self-advocacy is more related to activity than theory. Given the relative novelty and the lack of practical knowledge of self-advocacy techniques in comparison to their general perspective, it is even more important to pursue this pragmatic approach; showing real examples and exercises along with the sound theoretical basis necessary to understand the aim of self-advocacy and the practices provided.

Another important point to consider, is that this Unit’s aims can be easily summarized as “train the trainers”, as the ultimate scope of the process is to enable trainees to acquire the necessary knowledge and skills, in order to subsequently train the people they assist to become self-advocates, because of this future transfer, a clear and simple language and approach is used in order to facilitate the comprehension by both the trainees and their addressees, people with intellectual disabilities, in the subsequent training activity, a phase at which clearness and simplicity are crucial features.

Therefore, the first part of the Unit provides a theoretical framework about self-advocacy’s components and their definition, supported with academic research results, to gradually shift towards a more practical approach ending up with some proposed activities to be performed, in order to practice and develop these skills.

It needs to be noted here that most of the research about self-advocacy’s results or outcomes are related to self-advocacy groups, while most of the practices provided come from experiences with individual students in schools.

The perspective of this project takes into account that self-advocacy techniques can be taught, learned and applied in a wide range of situations, so, to some extent, no distinction is made between a group or individual training environment for people with intellectual disabilities. This can be easily understood by thinking of topics such as people’s rights, in which there is no actual need for a collective setting, at least for what pertains to learning about them.

Nevertheless, it is recommended that at some point the concepts and practices of this training are applied within a group. The time to do so shall be decided on the basis of the individual progress in the process and, obviously, given the theme, of the individual’s own decision. It is made obvious within this Unit that these two factors are strictly connected to each other.

The same decision is to be applied to the “debut” of self-advocates into a wider context, outside their everyday life environment: this can mean both speaking in front of other self-advocacy groups and in front of people without any disability.

This is a passage that, even if risky, should be taken into account, as it is very important in terms of self-advocacy application and success.

Many authors to this day, also in a veiled way, give the impression that they prefer a sheltered, secure dimension of self-advocacy groups rather than their effective and impacting role on the whole society.

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Topic 1: What Self-Advocacy Is

Self-advocacy is an important ability that is crucial for all the people.

Starting from the basic and classic definition by VanReusen et al (1994), defining self-advocacy as "an individual's ability to effectively communicate, convey, negotiate or assert his or her own interests, desires, needs, and rights", we can immediately understand that self-advocacy is an issue relevant to all people, regardless of their conditions.

In fact, it relates to poor and rich people, to young and older people, to people with disabilities and the so called "able bodied" as well.

The above-mentioned definition additionally states that self-advocacy "involves making informed decisions and taking responsibility for those decisions". This highlights that this topic is related to the access of information and to the responsibility for choices, in so much that we can say that self-advocacy is first of all a political issue. This is in the sense that it relates to the rights of people, for example, to participate and be included in society, even more than in the sense that it is something that is or should be object of policies.

Self-advocacy, nevertheless, in this context relates to people with disabilities, particularly those with intellectual disabilities.

Starting from a general perspective we will gradually go deeper into the issue, in order to finally provide knowledge, skills and tools to allow people with intellectual disabilities become self-advocates.

Self-advocacy is an ability that is not given for anybody as people have to learn and to cultivate it.

We can imagine a simple everyday life situation such as someone skipping the queue at the supermarket and someone else complaining about it. This is a very basic example of self-advocacy, of the kind people typically learn to express during their life, usually through imitation or education provided by family or school.

In the situation described above, some people would let it go while some others would express their feelings about it.

This is a primary difference, originating from individual character (in a way a cultural construct), and education, and/or their personal momentary condition. The same person, in fact, could get angered or not, on the basis of past experiences in their day so far. For example, using this occurrence as an excuse to unload their rage.

Moreover, other elements can contribute to determining the reaction: for example, feelings like fear or empathy, or racist or sexist views.

When it comes to more complex settings, we can add other motivations to a reaction (or to the lack of it).

A worker, for example, may not stand for his or her rights because of fear but more often because he or she lacks proper information about them.

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The same applies to a wide range of situations where disinformation or misinformation can play a major role.

1.1: Elements of Self-Advocacy

On the basis of the previous example and considerations, we can begin articulating that self-advocacy is, on the one hand, related to personal factors and, on the other hand, related to **communication**.

At this stage, personal factors include what we have described, such as education and individual character, which are nonetheless cultural constructs. As such, they influence the way a person behaves in relation to social contexts, families, friends, community, wider society.

Thinking of oneself, everyone can clearly see how what is commonly called "character" changes in relation to different context: a shy person can be so in a wider social context (school, workplace, etc) but often we discover that they are not shy when they are in an environment where they feel comfortable, such as with friends or family.

So, we can say that our character, but also our identity, changes in relation to the context.

The same is valid for all the people, included those with a disability.

When it comes to people with intellectual disabilities, we have to take into account that the environment not only plays a major role in their disability (that ICF says to be the result of the relation between personal conditions and social environment) but that, because of the major social stigma, this kind of disabilities is even more heavily influenced by the environmental or social factors than others.

Moreover, individual personal factors appear in the definition of self-advocacy, as the objects of the communication activity: interests, desires and needs.

The latter are related to disability again as, on the basis of different disabilities, people express different needs.

Recapping, in self-advocacy we have to take into account: interests, desires, needs, based on the characteristics of a particular disability, and the goals and dreams of each person alongside a set of features that can be grouped under the name of **Self-Awareness**.

Then, we have another object of communication in self-advocacy, clearly addressed in its definition: **rights**.

In this field, a major role is played by access to information and proper education as the first step to claim or defend our rights is knowledge of rights.

Self-awareness and rights' knowledge are our two first elements in the building of self-advocacy as a concept and as a set of skills to develop.

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Given the fact that self-advocacy is communication aiming to obtain a result, having one's opinions, needs, desires and rights satisfied, it is a form of exercising social influence and so, also in its basic form, it is related to the concept of **leadership**.

Now, we have a complete frame of the elements of self-advocacy:

- Self-awareness
- Rights
- Communication
- Leadership

These will be the topics addressed in the following pages, in order to understand the main subtopics that made up each of them, the method to gain information and skills related to them and their overall synthesis in an effective self-advocacy.

Until now, we can say that these elements are interrelated and have continuous positive and negative exchanges in the practice, especially in the context of people with intellectual disabilities.

For example: assuming only shyness as an individual feature, the individual basic skills to communicate can be negatively affected by this characteristic. Gaining knowledge of his/her rights (mastery of the topic) and working on him/herself to overcome shyness, his/her communication starts to be more effective.

The effectiveness of this communication positively affects his/her self-awareness under various points of view: increased self-esteem, increased confidence and other positive outcomes that slowly help overcoming shyness and generate a more positive approach also to "study" his/her rights.

This process, at the same time, generates a sense of leadership in the person that in turn would enhance communication and so on, in a virtuous circle.

1.2: Self-Advocacy Skills' Development

Summarizing, we can say that the basic elements for gaining self-advocacy skills are:

- Education
- Information
- Training

We write training as a distinct feature not only to mean that it is a kind of formal education but also because it better encompasses the presence of exercises and practice. It is important indeed to remember that practicing and exercising can not only help people to learn, but they can help people to learn in the moment and, also, to learn to change their acquired and structured behavioural patterns, if needed.

Going deeper into the issue in relation to people with disabilities, we can note that people with certain kinds of disability do not require different or more education, information and training than anyone else.

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In this sense, usually the main barrier to self-advocacy is social stigma and the related personal feeling of people with a disability themselves.

It is clear that there is no real difference if a person claiming for something is a wheelchair user or not.

The only problems are the possible well-known pietistic attitude of those receiving the claim or, on the other hand, the possible shyness or distress of the wheelchair user due to stigma but, theoretically speaking, the wheelchair user is perfectly able to understand and stand for his or her rights.

Differently, when we talk about people with intellectual disabilities or learning difficulties, we have to take into account not only a greater social stigma, still ever present, but also the presence of additional barriers to access education, information and training and, therefore, to the understanding of the people with disability themselves.

As clearly expressed in ICF, we now know that barriers are environmental factors negatively affecting people lives, reducing their performance, and finally defining the extent of the disability that the environment creates in relation to the persons' health conditions.

Given the complexity and diversity of intellectual disabilities, it is not simple to remove these barriers and even more to provide indications and methodologies which are generally applicable and effective.

Some simple guidelines can be provided below:

First of all, it is important to remember that it is impossible to claim and defend rights if they are not known.

Therefore, it is fundamental to provide people with intellectual disabilities with information and explanations about their rights.

This is a step that cannot neglect the direct involvement of families, schools, therapists, doctors and all the people regularly coming into contact with the individual. All these agents should be aware of the rights of the person and should share the same aims.

Families themselves, sometimes, in fact, tend to deny their relatives' disability rights, for example, the right to self-determination, as they assume they aren't able enough and dismiss the issue as useless and/or because they fear a possible failure and consequent depression or distress for their relatives.

It should be noted that these fears are quite commonly experienced by the person with disabilities themselves, so it is important to reassure and support them and not reinforce their fears.

In the following section we will discuss two interesting and different testimonies from two people with disability produced at different times, both refer to their distress and difficulties in trying to deal with their situation and the later acknowledgment that it was worth it.

In the 2003 Italian Book "Diversabilità: storie e dialoghi nell'anno europeo delle persone disabili" (Diversability: stories and dialogues in the European year of people with disability) a man with Down syndrome speaking about his life recalls that, "going to the psychologist weighed on me, because

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he made me reason on things I didn’t want to think about as for example the handicap and ‘flying with imagination’. Now I have a good communication and I talk to everyone without making differences”.

In 2016, a woman involved in the first Italian self-advocacy platform, said “I had some difficulties as the facilitators [persons supporting self-advocates both individually and in group] make us reflect on aspects sometimes even a bit unwelcome, but I realized that their help has been fundamental to solve some situations”.

Even people who have a less frequent and non-care related relationships with the individual with disability should be informed and educated, as their possible negative or non-collaborative attitude can contribute to progress failure.

Indeed, recently, social stigma and negative attitudes toward people with disabilities, generally speaking, seem to be reducing. This is not necessarily true for people with intellectual disabilities who are often treated as “mad”, albeit without malice, on the assumption that they don’t understand anything and so they will not suffer from the rudeness or insensitivity of others.

It is on the contrary, it is actually very important to provide support and guidance to people with intellectual disabilities in order to facilitate the process of self-advocacy.

So, information, education and training have to be provided not only to people with disabilities but first to people surrounding them.

Another important aspect not to be neglect is the issue of facilitators: under this umbrella term, we can group both aids (technical, prosthesis and orthosis; technological, assistive technologies, etc) and human resources such as assistants, special education teachers, caregivers, SLOs, relevant officers and so on.

It is important to provide people with intellectual disabilities with relevant information about these aspects and also to support them in addressing the various possible services available to them in various contexts.

1.3: A Self-Advocacy Programme

Simplifying, the steps for setting up a self-advocacy programme are:

- Evaluation of involved people with disability conditions.
- Evaluation of barriers and facilitators to their empowerment.
- Definitions of the goals of the programme
- Definitions of means to reach these goals.

These steps are intertwined and their inclusion affects the whole programme.

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All the 4 steps are meant to be performed together with the individual with intellectual disabilities and not on their behalf.

An evaluation of the needs of the people involved in a self-advocacy programme is the first step, because based upon the basis of this evaluation, the correlated barriers and facilitators can be identified in order for goals to be reached.

In the context of self-advocacy, this evaluation is a double process as, on the one hand, it encompasses a self-evaluation by people with disabilities themselves and, on the other hand, it involves an evaluation to be performed by specialists on the basis of scientific tools available.

People with disability, and even more people with intellectual disabilities, will often undergo continuous checking, assessment and evaluation, according to the different regulations of the country in which they live. However, it may be possible that none of these assessments would be useful for our purposes.

One worldwide known example of a tool that can be used for this evaluation is the International Classification of Functioning, Disability and Health (ICF), which provides codes for the description of a wide range of personal conditions in their social context: both letter B, which refers to Body Functions and letter D which describes Activity and Participation, are particularly relevant for self-advocacy. Moreover, under letter E, the ICF provides a list of possible barriers and facilitators to further detail the framework in which the self-advocacy programmes have to work.

The activity and participation domain alongside the barriers and facilitators (i.e., the social environment people with disability live in) are very important to identify what has to be taken into account and in order to define the training needs of families, caregivers and assistants and other professionals.

So, once we have evaluated the potential capabilities of people with disabilities based upon their current circumstances and once barriers and facilitators have been identified, we can set the aims of the programme.

People have different capabilities so it is important to define realistic (but, nonetheless, high) goals to be reached and paths to attaining them, which should be as individualised as possible.

This does not mean that we have to consider the individual learning alone, as also given the social dimension of social advocacy itself, for certain subcomponents of self-advocacy, group experience seems to better fit the scope of such training.

Moreover, the involvement of relatives, caregivers and assistants in the trainee's group for some topics could help optimization of costs and time, not to mention the possible need to exploit these occasions in order to allow people to get in touch with people with disabilities.

1.4: Dimensions of Self-Advocacy

Self-advocacy is an ability to perform some tasks or apply some skills. It pertains to the personal development of the person in a social context.

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Its dimension is social but clearly it also contains aspects pertinent to the individual. This is reflected in the body of research, with authors highlighting both aspects. This applies also to the results of research alongside the included activities of self-advocacy and so to the aims of the research

This double dimension of self-advocacy is also evident in some definitions: on the one hand, we have those highlighting that self-advocacy is an ability, a set of skills or actions performed by an individual. On the other hand, we have definitions addressing self-advocacy as a movement.

Fenn and Scior (2019) report that “Some researchers (e.g., Goodley, 1997) have described a tension between self-advocacy as a means for *individuals* to ‘speak up’ and affirm their preferred identities, and self-advocacy as a *collective* movement representing the interests of a particular group” (p.4).

In addition, some authors (particularly Anderson and Bigby) tend to consider self-advocacy as alternative to other approaches or activities. For example, they argue that “community living had undoubtedly been a positive step” but “the failure to offer adequate support for community engagement or the development of relationships has more often meant people are physically present rather than socially included in communities (Bigby, 2008; MacIntyre, 2008). Similarly, social integrationist approaches that sought to build inclusion through employment have had limited success, and the economic participation of people with intellectual disability remains remarkably low (OECD, 2010). This approach to inclusion requires people with intellectual disability to have the ‘capacity’ to undertake paid work (Johnson et al. 2010) and seems to seal the exclusionary fate of those unable to participate for a range of reasons”.

It is quite interesting that in the same publication, the authors, who criticise both the community living approach and that of job placement of people with disabilities in sheltered (and non-sheltered) contexts, so creating an opposition between self-advocacy and these two approaches, then write that “Whilst the self-authored space is a segregated one, it seems to mimic spaces in the mainstream community, such as the football club, the community choir or the self-help group, that act as catalysts for inclusion as well as peer relationships, and the development of individual and shared common interests. For people with intellectual disabilities, self-advocacy groups are a key self-authored space”.

Later on, they specify that “Self-advocates deeply valued the business-like processes of their group: the rules, infrastructure and activities, whether they worked in a paid or voluntary capacity within it. The assignment of tasks gave them a sense of trusted self-determination, and their participation the identity of ‘worker’, an identity many had been told (or had understood) that they could never attain”.

Now, there is a clear contradiction in considering the value of the workers status gained through paid or voluntary work within a self-advocacy group and the dismissal of the benefits derived from working outside it, on the basis of the sole economic participation data provided by the OECD.

Clearly contradictory, as well, is that whilst they think that inclusion through employment is based on the “exclusionary” prerequisite that people with intellectual disabilities should be able to work, they don’t identify with those who state that people with intellectual disabilities would never have attained the workers identity.

Moreover, it seems that the authors really underestimate their own recognition of self-advocacy groups as “segregated” space, especially in comparison with their critic to the community living

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approach and also considering that in their introduction they seem to embrace Johnson et al.'s statement that nothing "good or normal" can be produced by segregation.

A consideration shall be made also in relation to the reference of OECD indicators. Those indicators can clearly help better describe people with disabilities conditions in various contexts and also provide some evidence of their well-being but, as the OECD itself admits "Well-being has several dimensions of which monetary factors are only one".

Economic indicators and measurements are also present in an increasingly used approach known as the Capabilities approach, that in some Countries (Italy among them) is widely applied in the field of social assistance and self-advocacy.

Problems may arise from the fact that this approach has a history of being seen in contrast with the ICF model, however some authors, such as Bickenbach, have stated the opposite to be true, suggesting that the two approaches are "potentially synergetic".

Beyond theoretical disputes, we take a cue from the above considerations to say that we believe that self-advocacy could be or better should be useful when integrated within many contexts, regardless of most theoretical approaches.

In the meantime, it is of utmost importance to avoid that self-advocacy groups become ghettos, reproducing the segregation of institutions, only without violence and abuse, on the basis of protective purposes. This would totally betray the self-advocacy significance.

It is true that the Normalisation movement failed to identify key features of the problems it wanted to overcome, but it is nonetheless true that the concept of "dignity to risk" is a seminal one for the development of the self-advocacy idea and movement and overall, still valid nowadays.

So, to close, we have to remember the two fundamental dimensions of self-advocacy: individual on the one hand and social on the other one. These have to be pursued all together even if we don't think that the ineluctable fate of self-advocacy activities is a self-advocacy group.

In the next section, we will describe how self-advocacy activities and outcomes pertain to the social domain, as well as to the psychological, individual domain. Discussing how self-advocacy training can be effective and versatile enough to be used in various contexts and with various aims.

1.5: Self-Advocacy Outcomes

Looking at the literature on self-advocacy, including studies and self-advocacy curricula comparisons, we can outline what outcomes are likely to be produced by self-advocacy training:

- More social connections both with other people with disabilities and generally speaking
- Positive redefinition of their identities, both in terms of social identities and self-identity (or self-concept)
- Empowerment - described by social scientist Julian Rappaport (1987), as a "concept (that) suggests both individual determination over one's life and democratic participation in the

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life of one’s community… both a psychological sense of personal control or influence and a concern with actual social influence, political power, and legal rights” (Rappaport, 1987)

- Belonging - defined as, “a feeling that members matter to one another and to the group, and a shared faith that members’ needs will be met through their commitment to be together” (McMillan & Chavis, 1986)
- Leadership
- Confidence
- Occupation, also as job, and more significant activities
- Sense of agency

We remember that these outcomes are derived for the most by the analyses made by Fenn and Scior (2019) and by Tilley et al (2020) about self-advocacy groups and only to a little extent by the review of the self-advocacy curricula actually used in some schools, so that there is a clear bias resulting in more “socially” oriented outcomes.

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Topic 2: Self-Awareness

Various studies have highlighted the indissoluble link between self-awareness and self-determination. Even in the already mentioned definition of self-advocacy by Van Reusen et al, there is a clear reference to the ability to make informed decision; not only is decision-making one of the key-components of self-determination along with choice making, self-observation and self-knowledge but self-awareness itself is one of them.

Therefore, our training will provide information about all the above concepts in order to allow our trainees to help people with intellectual disabilities exploring and developing their self-awareness.

2.1: Self-Knowledge

Self-knowledge “refers to knowledge of one’s own sensations, thoughts, beliefs, and other mental states” (Stanford Encyclopedia of Philosophy, online).

Having a long and complex philosophical history, it is enough to say that for our purposes, self-knowledge is necessary for people with disabilities as one of the foundations self-determination is built upon. This could be among the key issues self-advocates have to express and to advocate for.

People with disabilities have to know and to express their thoughts, feelings and beliefs just like everybody else and our duty is to provide them support in doing this.

Almost all the self-advocacy curricula, indeed, start from concepts and tasks that are somehow related to self-knowledge. Given the fact that self-knowledge is naturally displayed in activities requested at the beginning of every relationship, even less structured than a training, such as questions about the person, self-introductions, and so on.

First of all, people have to comprehend information about themselves – their feelings, needs, desires, wishes and conditions – and then learn how to explain this to others.

This knowledge is not only aiming to enable the successful communication of relevant factors but it also aims to be part of a process allowing people with intellectual disabilities to better understand themselves. Additionally, this analysis by reflection and comparisons of what they think of themselves can be performed throughout the whole duration of their self-advocacy training. New concepts and experiences in fact have been proven to cause changes in the self-concept itself.

Basic, initial activities, also have the purpose of allowing the trainer to gain knowledge about trainees, which can be seen as the first steps for people to start exploring their self-knowledge and this can be particularly true for people with intellectual disabilities as given their often more isolated condition this can be one of the first or of the few occasions to express something like their views, feeling, needs, preferences and so on.

Therefore, simple but very useful actions can be requested such as: introducing themselves, introducing their preferences, talking about their wishes, their likes or dislikes, their hobbies and so on. This can be done both via speaking and writing, and both in a collective or individual settings.

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It can be applied to general or specific areas and subjects according to various aspects to be taken into account.

At first, in every new social situation, you need a warmup time, where most of the talking is aimed at getting acquainted and gaining mutual confidence, to break the ice. So it goes also in a training, both in one-to-one relationships and in a group, with the difference being that the trainer could deliberately use this time to also collect first pieces of information and impressions of the trainee and to encourage the interrelations among the participants in order to make everyone feel at ease, to avoid conflicts and so on.

Actually, everyone does this at various levels and in a more or less conscious way but the difference is that the trainer is in a position of authority and that it has more tools for analysing what is happening; not least, his/her aims are completely different from that of the other participants in the relationship.

On the basis of the involved people's behaviours, characters and attitudes and on the basis of contextual factors as well, this time can significantly vary.

Imagine a one-to-one training where the trainee is a very shy person. Clearly, the warmup time will be longer than with a more extrovert trainee and it is up to the trainer to gain the person confidence and to find strategies to do so.

This very basic example is also valid for wider contexts, where there are more variables and the strategies to accelerate the process can be more complex. An additional difficulty in a wider teaching context is that you can have very different levels of responses by the trainees, and differences in terms of time required to grasp the concepts. The trainer has to be conscientious of being able to maintain the general pace without leaving some people behind.

For example, you can decide that it is understandable that a person may not want to speak much and just says a few words during the first meeting, but you have to try to involve him/her more during the sequent meetings. This can involve recruiting other participants' assistance, in order to reach a good level of interaction among all the participants facilitating everyone's comfort and a sense of community and so, in the end, of belonging.

Nevertheless, on the other hand, during this fundamental phase we are collecting a lot of information in both a direct and indirect manner.

Once the acquaintance process is over, we have to continue to encourage people to speak about themselves in a more structured way.

So, you can ask the trainees to perform simple tasks such as answering some questions, oriented to obtain personal information directly from them.

You can ask for preferences about food, movies, sports, school subjects, duties on work, what they want to do in their life, their wishes and desires, how they see them in the future, how they feel about their disability and what they think it could help them in various fields.

All this information has to be processed and analysed during time with the trainees. On the one hand, you can help them to better define their aims and get feedback about the process, on the other hand, they can understand if something is possible or not, understand the difference

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between needs and desires and the differences in themselves during the various steps of the training.

Self-advocacy literature quite frequently presents the cases of people with disabilities whose involvement in self-advocacy training and groups leads them to change their desires or, better, goals, usually setting higher ones.

Particular attention has to be paid to the strengths and weaknesses identified by the person as they are the basis of self-evaluation, a fundamental ability for goal-setting and self-determination in the wider sense. Finally, self-evaluation and evaluation skills are also important to self-advocacy, because of their strong link to the recognisance of needs and to the advocacy for proper interventions and adjustments.

A less obvious subject of the self-knowledge process is the knowledge of the condition of disability itself.

It is evident that people with disabilities, so including those with an intellectual one, clearly experience the dimension of disabilities and know it but there is a lack in educational knowledge about it. They need to be aware not of disability as an experience but as a concept, with correlated constructs including tests (i.e., evaluation and assessment methodologies), the academic point of view and the general population's opinions on it. This knowledge is a necessary step to start proper self-advocacy. Moreover, comprehension of these contents can help them to better understand their weaknesses and strengths, linking their own perception (or self-perception in this case) to a "neutral" one, represented by coded results and observations, like IQ tests' scores and other technical means.

The provision of information about disabilities to people with disabilities themselves is not granted at all, especially talking about people with intellectual disabilities, because of the social attitudes towards them: overprotection, ableism, paternalism and lowered expectations are still nowadays cultural barriers preventing them to access a more professional information about their own disabilities.

In this case, having to provide and explain a set of information, the intervention of the trainer and of other people as well is a more overtly instructional one.

Later on, we will provide general indications about how the trainer shall provide information, especially written materials, accessible to people with intellectual disabilities.

2.2: Choice Making, Decision Making and Problem Solving

Strictly linked to the concept of self-awareness, and often a contributing cause of it, is the process of choice making and the almost overlapping concept of decision making. Also, in scientific literature these two concepts are often use as synonyms, with a marked preference for the term decision making.

Looking at the history of the terms, it seems probable that we can say that choice making refers to a structured but more naive process, whereas decision making has been used since the beginning

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to indicate a structured and organic process, as it comes from the language of the public administration and has been transferred to professional contexts in the middle of 20th century.

Certainly, there is a strong link between the two processes as the result of every decision making is a choice and the process of choice making according to some definitions encompassed a decision making phase.

Beyond theoretical issues, decision making (from now on we'll use it as a synonym of choice making) is important to self-advocacy because of the rights to free choice and to self-determination.

The most used and studied curricula of self-advocacy includes some kind of decision making and, in some cases, the decision making and the related problem solving process is central or just represent the whole curriculum.

We note that some authors establish an identity between decision making and problem solving, whereas the first is the European concept corresponding to the US idea of problem solving. Actually, we will use the terms as different being that problem solving is the ability and the process of aiming to identify a problem and its possible solutions and the decision making is the ability and the process allowing to choose the solution to be implemented.

The overall importance of decision making and problem-solving skills to self-advocacy is given by the fact that the identification of solutions to problems is what makes self-advocacy a practice, leading from theory and analysis to action.

Even speaking out, the most basic self-advocacy activity, is linked, even subconsciously to the processes of problem solving and decision making. For example: I feel uncomfortable about something (Identification of the problem), I think that I can advocate for a change (Evaluation of possible solutions and Decision Making), I speak up (Decision taking or implementation).

As a practical wider example, we are now going to illustrate the "DO IT!", a decision making process used in "Whose Future Is It Anyway?", a curriculum for planning the transition of students with cognitive and developmental disabilities and aiming at give them the possibility to lead the curriculum and the transition themselves.

DO IT! is a pun as it urges the individual to act but it is also the acronym of the phases of the process:

- Define the problem.
- Outline your options.
- Identify the outcome of each option.
- Take action. Get excited!

Another self-determination curriculum used for transition from school to post-school settings is ChoiceMaker, Self-Determination Transition Curriculum. This curriculum, among its seven self-determination constructs, enlists decision-making.

Also, some instructional models like the Self-Determined Learning Model of Instruction, developed by Shogren, Raley, Burke and Wehmeyer, are centred around problem solving skills.

It is important to remember that not only the initial activities of expressing one's own needs, preferences, strengths and weaknesses help in the basic phases of problem solving and decision making processes, i.e., the definition of problems and the possible solutions to them on the basis

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of the individual’s conditions, but also the dimension of environmental factors has to be taken into account.

Options to overcome these problems, in fact, are related to the persons abilities, yet these are heavily influenced by the environment they live in. In this environment, as said, there are barriers and facilitators and we have to consider these to find our solutions.

Practically speaking, solutions for people with disabilities problems sometimes rely on external factors, such as people supporting them, aids, assistive technologies, adjustments and accommodations.

We can imagine a student with learning disabilities identifying among their problems, reading. This problem causes other spill-over effects, such needing a longer time to do homework, difficulties in following classes, and so on.

Identifying the limited ability to read as the originator of other problems, the student has started to problem solve. Now, the student has to decide what solution better fits their situation, so they may list and evaluate all the possible solutions.

The student thinks about the possibility of getting a teacher or classmate to read for them but soon may realise that this option has limitations: this means the student is always dependent on someone else, the teacher may be not available and the classmate can’t be always present, for example in the afternoon when homework is done.

So, this option is discarded and the idea to use a reader software is taken into account. Now, this is a solution the student likes very much as it seems to be to use and perfectly fits their needs. Unfortunately, the school has no computer available during classes, so this solution can be applied only at home. The special education teacher knows that for that school year the government can provide funding in order to buy assistive devices for students with disabilities, they inform the student of this. The student can subsequently apply for the grant and finally can buy their own device.

In this example, we can see a series of self-advocacy related issues: on the one hand, we have a student recognising a problem and taking action to solve it. On the other hand, we see that there is a context (the school one) that shows both barriers and facilitators, as the lack of instruments and as the presence of human resources willing to help. There is a process of problem solving and decision making happening and the role of professional figures (the special education teacher) who act as facilitators providing key information (about the grant).

So summarising, this example shows: the person with intellectual disabilities’ recognition of their own strengths and weakness, the problem-solving process and the correlated self-advocacy in expressing the need. The assessment of pros and cons of the various solutions, even involving other people. The importance of information and professional figures, relevant to the process.

As we will see in the scenarios section, the knowledge of roles and the ability to identify particular persons as in charge for relevant area pertinent to people with intellectual disabilities lives is very important in self-advocacy as it means the possibility to be provided with relevant information, help and assistance.

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Topic 3: Communication

Being one of the core activities of self-advocacy and being also central in training, we are now addressing some useful information about communication.

Communication is every process in the transmission of information. The basic elements are a sender, a message, a receiver.

With a very basic example: the person speaking is the **sender**, what the person is saying is the **message** and the person(s) listening is the **receiver**.

Now, imagine a person speaking Chinese communicating with another person who doesn't speak Chinese. Communication will be ineffective, as there is no shared code (a common language, in our example).

Therefore, the **code** is another important feature of the communication process, we have to take into account.

In another example, our unlucky Chinese-speaking person talks to a Beijing native but nonetheless the receiver seems to not understand. The receiver is a deaf person so in this case the problem is not the code, but the fact that the sender is speaking, i.e., the means used to communicate, that is called the **channel**.

In both the examples, the communication is ineffective, yet communication occurs, indeed the persons know that they don't understand each other, so a message has been transmitted.

This is because in our examples there is a mutual acknowledgment that the channel or the code is the wrong one. This is probably achieved by gestures or only by decoding the failure of attempts to communicate (in the sense of what the receiver wanted to say).

In the case of a person saying (in various ways) "I cannot understand you" as a reaction to the sender's communication, we can say that we have an example of **feedback**, another important element in the process.

Feedback is every kind of reaction to the message of the sender and this is particularly important because through it the sender can evaluate the effectiveness of their message and if required accordingly modify their communication. In the latter option, the feedback has been a negative one. Positive feedback, on the contrary, confirms that the communication is effective and that the sender can continue to communicate in the same way.

Above, we have mentioned gestures as a means through which the receiver releases feedback. This gives us the opportunity to introduce other important notions about the communication process.

Communication, we have said, occurs in various ways and it is sometimes involuntary. According to the so-called Watzlawick first axiom, in an interaction, participant behaviours have the value of a message, so that it is impossible not to communicate. In Watzlawick and colleagues' own words: "Activity or inactivity, words or silence all have message value: they influence others and these others, in turn, cannot not respond to these communications and are thus themselves communicating".

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Even if one can think that this applies only in presence of another (Watzlawick and Beavin themselves), this is not true if we think to a wider communication context: even the hermits and the cloistered nuns communicate to the society, exactly through their absence.

Not only do speaking or not and moving or not actually communicate something but we have to be aware that a lot of involuntary movements and also behaviours can communicate a message.

This is important to take into account because we can use this knowledge to better communicate. Given the purpose of this training it is both important to keep in mind what we are going to learn so that you can apply this information to be more effective when you will deliver self-advocacy training to people with intellectual disabilities and also to provide them with some tips to be successful self-advocates.

The efficacy of communication relies on three elements:

- Words meaning.
- Voice tone and characteristics.
- Nonverbal language.

Maybe you don't know that more than half of the communication success depends on nonverbal language.

So, we are now going to introduce communication skills and then we will provide some examples about their use.

The communication skills include:

- Language related skills (the ability to produce and interpret verbal signals).
- Paralanguage related skills (the ability to use emphasis, volume, intonation, exclamation and so on).
- Kinesics skills (the ability to communicate through gestures and facial expressions).
- Proxemics knowledge and skills (the ability to use and interpret interpersonal distance and spatial orientation).
- Performance skills (the ability to use verbal and nonverbal acts to realise the communicative intention).
- Socio-cultural knowledge (the ability to identify and categorize social situations, relationships and roles).

As you can see, most of the skills in the list are not related to the language itself.

Many examples can be used to improve trainees understanding of the communication features and even strategies, for example, watching and analysing movie pieces together or gestures during political speeches.

As one can easily understand, role-playing and simulations, even using scripts, can be helpful to practice these skills.

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According to most of the literature available on the themes of self-advocacy, not only do self-advocate make use of scripts for many purposes, but sometimes they are not written on their own but only read by self-advocate and still the practice seems to be effective in attaining positive outcomes.

Given that your final trainees are people with intellectual disabilities, you can start working on a few basic issues.

Remember that a lot of people, including people with intellectual disabilities, are not fully aware of what they are doing with their bodies when speaking.

Recordings of speech sessions and their subsequent analysis can help people adjust their style. Nowadays this is made quite simple given the ubiquity of smartphones that can be used to do this.

At first, you need to set a few rules for appropriate communication and after initial training, including observations and exercises, you can progress to a more advanced level, where you will teach your trainees some techniques that can be useful in their self-advocacy speeches. Remember that not everyone is a master in oratory, the art of eloquence in rhetoric and discussion, but nevertheless you can provide information and practice about it: how to articulate the speech, how to use the voice, tone and volume, in certain circumstances and even how to use body language and proxemics.

Some people with intellectual disabilities face major challenges not only in speaking but more often in socially appropriate control of their voice, body and in the respect of what is socially perceived as appropriate distance from the interlocutor.

3.1: Kinesics

Some people, for various reasons, tend to move their hands a lot or to move themselves, for example swinging. Most of these movements are unconscious and often related to emotions. However, on occasion too much movement could be distracting to the audience and some movements can also reveal negative feelings (such as anxiety or lack of self-confidence) so may reduce the effectiveness of communication.

Particularly, gestures can be classified into five categories:

- Emblems, substituting verbal message, for example you can show two fingers to say that something costs 2 euros.
- Illustrators, reinforcing a verbal message, for example you can do a circle with your hand when you say something is circular.
- Affective displays, communicate about emotions and feelings, for example smiling or folded arms or nervously movements of a leg.
- Regulators, help to regulate the conversation and turn taking, for example moving the head as saying "yes" to show that you are following the speech or move your hand to request a stop, give the floor to another's speech.

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- Adaptors, they are primarily a means of relief. Examples are hair twirling, pounding of fist, nose scratching.

Actors but also good speakers can use all of these gestures and cues in an intentional, conscious way in order to transmit a certain message or to reach a certain goal. Most people, on the contrary, display this kind of behaviour in an unconscious and sometimes contradictory way.

3.2: Proxemics

This is a term coined by cultural anthropologist Edward T. Hall who defined proxemics as “the interrelated observations and theories of humans’ use of space as a specialized elaboration of culture”. For our purpose, it especially applies to interpersonal communication.

Starting from the basic, it is related to the distance between interlocutors in a certain social context. Hall defined a range going from intimate to public distance, where the little is the distance the more intimate is the context. The areas defined by Hall are (in an increasing distance scale):

- Intimate distance
- Personal distance
- Social distance
- Public distance

For our training we have to keep in mind that not only public distance, as being used in public speeches, is important, aiming at the ability to self-advocate, but that often people with disabilities have to be trained also about socially appropriate distance in all the four areas identified.

Indeed, many persons with intellectual disabilities may have relational difficulties which often go along with inappropriate distancing: they may tend to have a social distance that overlap socially appropriate personal or even intimate distance, i.e., they can touch people they are talking with, even if they are not friends, or stay too close to them. On the contrary, other people avoid any kind of contact, sometimes even eye-contact, or stay too far away or aside.

Taking into account the individual attitude about this matter, it is important as a basis to elaborate our goals but also as one of the outcomes resulting from self-advocacy activities, even if not a primary pursued one but among the most appreciated by people with intellectual disabilities themselves – pertains the attainment of a business-like, more professional status.

Having said this, you have to consider the importance of proxemics when intentionally applied to communication. For example, in a class the teacher can reduce distance with students (by choosing to go behind their desk or walking among the students) to establish a more direct, horizontal relationship or to gain more attention from the audience. In the same way, an adult can lean forward or bend on his/her knees when talking to a child in order to establish more direct eye-contact but also to physically say “I’m on you level”.

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3.3: Basic Indications for Interpersonal Communication

Whilst the combination of knowledge and the use of language, paralanguage, kinesics and proxemics results in performance skills, social-cultural knowledge related to the identification of social situations, relationships and roles should be used to choose the appropriate language, paralanguage and body language required according to the context.

For example, you should teach people with intellectual disabilities that when talking to a stranger, not only it is appropriate to keep a proper distance but also that they have to use a certain kind of language and a certain degree of formality.

At first you have to set a few rules that can focus on the respect of basic good mannered. Rules such as, use a polite language, use a calm tone of voice, not to talk over the others, speak as much clearly as possible, be open to the other options and so on.

You can write, simulate and script conversations to be read by the person you are working with.

At first you have to focus on little, well-defined issue so to stay simple enough for the people to manage their speech.

Later on, you can apply role-playing to simulate some social situation such as a job interview or a meeting with friends, where different behaviours and contents are allowed. Other possible exercises include to picture someone talking in public using various sketches representing various possibilities in the fields of language, paralanguage, body communication and proxemics rules in different contexts.

For example, no judge would address the court saying “Hey you!” or no employees would talk to the boss putting the feet on his/her desk. You can define a set of rules (or even choose among determined ones, such as the ones applied in ritual or other strictly coded contexts such as in tribunals, in the church, and so on) and play a game with your students.

Another useful activity in this context is to watch movies’ clips and analyse them together both prior or after you introduced the above concepts to your trainees.

Something you probably will have to work on a lot is two important constructs related to communication:

- Assertiveness
- Negotiation

3.4: Assertiveness

Assertiveness is the ability to clearly and effectively express one’s ideas, beliefs and emotions in a self- assured and confident way.

The problem with this is that, for all of us, it is quite difficult to stay within the limits of assertiveness without becoming aggressive, offensive or presumptuous. Moreover, people with intellectual

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disabilities often range from being too passive to being aggressive or nervous and often they have problems of self-esteem or self-confidence.

Various components of self-advocacy will help, directly or indirectly, on some facets of this issue. For example, self-confidence could have a positive effect on the level of aggressiveness, passivity or anxiety of people with intellectual disabilities but, nonetheless, some explicit instruction and practices have to be delivered to them in order to exercise their assertiveness.

First of all, as we said people with intellectual disabilities have to learn to express themselves clearly. One means to be able to do so, is to train them about their rights or their disability. For example, so they have a better knowledge of what they want to say, this should help them to be clearer and more self-confident and secure.

On the other hand, they will learn that in assertive communication they don’t need to belittle the others and their opinions but they only need to rely on the goodness of their own reasons and motivations.

So, they need to learn to argue their opinions and needs and to say no and yes on the basis of reasoning.

This would help also to avoid problems related to assertiveness that are sometimes highlighted in the research. If a person in fact provides arguments for a certain position, instead of merely saying yes or no, you can start an activity that is called negotiation.

3.5: Negotiation

Negotiation can be defined as a dialogue or discussion between two parties aiming at reaching an agreement. It is characterized by the fact that neither party can (or wants to) impose his/her solution over the other’s and that a lack of agreement will bring less advantages to both the parties involved.

One basis of negotiation is that each of the involved parties has to consider the other’s needs, which can involve positive active listening, i.e., you have to carefully listen to the other, without any kind of prejudice nor an immediate formulation of judgement or advice.

The negotiation process can be grossly divided into 3 phases:

1. Planning
2. Implementation
3. Analysis and decision

In the planning, one decides what they want to obtain and the means to reach these aims (the strategies). It is good to set many different goals, ranging from the minimum acceptable result to the maximum one. The same goes for the strategies, as one has to be ready to change if one strategy is unsuccessful.

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Then, in the implementation, the person tries to express their demands and applies the decided strategy (for example trying to persuade the other by levering on emotions). The other person responds to this request, giving another opinion or making a proposal. So, there is a final analysis of what has been proposed and a decision about it that can result in the agreement or in continuing the negotiation (with lowered expectations by both sides).

3.6: Speech Organisation

Considering that self-advocacy is closely related to speaking up for rights, it is important that you help your trainees, people with intellectual disabilities, to gain some mastery over the organisation of speech.

As for all the people, but even more for people with intellectual disabilities that have to cope not only with emotion and anxiety derived from public speaking, it is very useful to be able to prepare a model, a script, to be followed during speeches.

All speakers usually prepare a script and some of them, even among people professionally experienced at talking in public, read it during their speeches.

To organise a speech, you have to know:

1. What you want to say, i.e., the contents of the communication.
2. Who you are talking to, i.e., your audience.
3. The goals you want to attain through your speech.
4. The space where you are going to talk, i.e., the context in which the communication is taking place.

Once you have cleared those aspects, you can start working on the contents of your communication.

Usually, a speech is organised in 3 phases:

1. Opening, within which we usually find 3 elements: self-introduction, the captatio benevolentiae (even in its simplest display i.e., salutations and thanksgiving) and the summary of the topics of the speech.

2. Storytelling (description of facts).

3. Epilogue: recap and again greetings and thanksgiving.

On the basis of these three simple phases, through repeated exercises, you can help your trainees to organise and write their scripts in order to have a better performance as self-advocates, so that in time they will acquire more and more self-confidence.

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Topic 4: Rights

People with intellectual disabilities, as all the other people, have various roles or identities depending on the contexts in which they are in a certain time.

So, when talking about rights, it is important to keep this in mind, in order to properly cover every relevant aspect of this topic.

A person with intellectual disability can be a student, a client, a patient, a parent, a son or a daughter. She or he is a human and a community member, a citizen, a worker, a consumer.

Therefore, relevant information must be provided, in appropriate formats, about:

- Human rights
- Citizen rights
- Consumer rights
- Patient rights
- Educational rights

Information should be related to the specific person’s circumstances and should aim to avoid mere, useless declarations and the usually complicated language of laws which can impede people from linking contents to reality, that is particularly true for people with intellectual disabilities who may already have some difficulties with abstract concepts. In addition, it is important to remember and to communicate that all the above-mentioned rights are respected, applying the necessary specifications provided for some groups of people.

For example, it is not enough to say that people with intellectual disabilities have the right to education but it is of utmost importance to provide information about how the right can be put into practice or realized, e.g., reasonable accommodations, and how to obtain these adjustments.

Some information pertaining to rights are available in plain language or easy-to-read formats (e.g., the Convention on the Rights of Persons with Disabilities) but more often this is not the case and these versions are made by organizations, individuals or specialized agencies.

This also applies one off events such as elections. For example, the Italian association Anffass (National Association of Families of People with intellectual Disabilities) in 2016 designed and provided a Guide for a Constitutional Referendum, in order to allow a real choice for the 2 millions of Italian voters having an intellectual disability.

Projects like Hurraki provides a plain language dictionary, in this particular case based on a wiki and available in 5 languages (English, German, Spanish, Hungarian and Italian).

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4.1: Rights and Duties

The more social and complex topic of rights can be used to introduce the related but not so overtly social theme of the duties and, thus, allows us to arrive at the self-awareness related issue of responsibility.

When talking to people with intellectual disabilities, it may be necessary to place greater attention to the language used, as it is necessary to avoid abstractions. Once introduced the right issue in the proper way, we can take an example that has been particularly well received by the person(s) with disabilities to link it to the other side of the coin, i.e., duties and responsibilities.

For example, if trainees have been introduced to the issue of the right to education and the proper adjustments required, we can say that as the school has the duty to provide them, students have the duty to study.

4.2: Accessible Information – Easy to Read

Information must be accessible. In the case of people with intellectual disabilities, this means that it has to take into account some specific features like:

- Language: it must be simple and direct. Sentences must be short and clear. The use of dependent clauses has to be avoided as much as possible. Technical words and jargon are not to be used. Abstract concept and metaphors have to be replaced by more concrete words having a more direct relation to everyday life even recurring to examples.
- Graphic design: page layout and types must be simple. Font shall be large print and with a good contrast. Italics is not recommended while bold characters and/or different color (always providing good contrast) should be preferred to highlight the most important contents. Alignment must be considered, avoiding justified texts.
- Images: use of photos and images can help a better understanding of the text

An example of easy read language is given by the United Nations itself, providing also an easy-to-read version of its Convention on the Rights of Persons with Disabilities (CRPD).

A brief comparison of some articles of the Convention:

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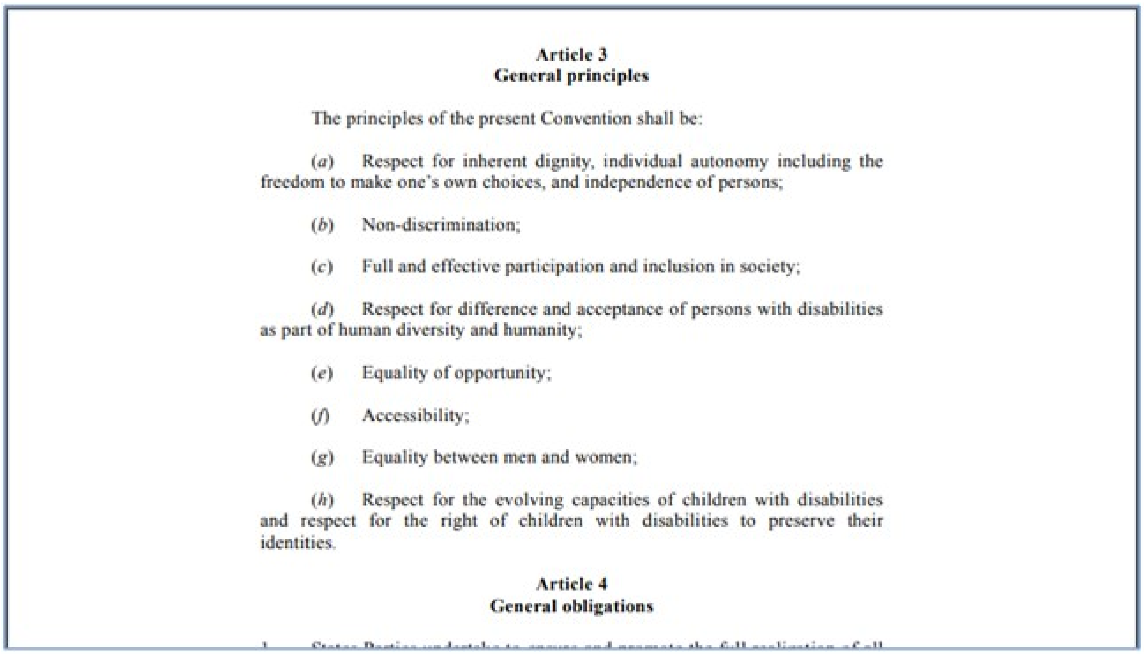

Article 3
General principles

The principles of the present Convention shall be:

(*a*) Respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons;

(*b*) Non-discrimination;

(*c*) Full and effective participation and inclusion in society;

(*d*) Respect for difference and acceptance of persons with disabilities as part of human diversity and humanity;

(*e*) Equality of opportunity;

(*f*) Accessibility;

(*g*) Equality between men and women;

(*h*) Respect for the evolving capacities of children with disabilities and respect for the right of children with disabilities to preserve their identities.

Article 4
General obligations

Figure 77: Image of the Article 3 of the Convention on the Rights of Persons with Disabilities (CRPD)

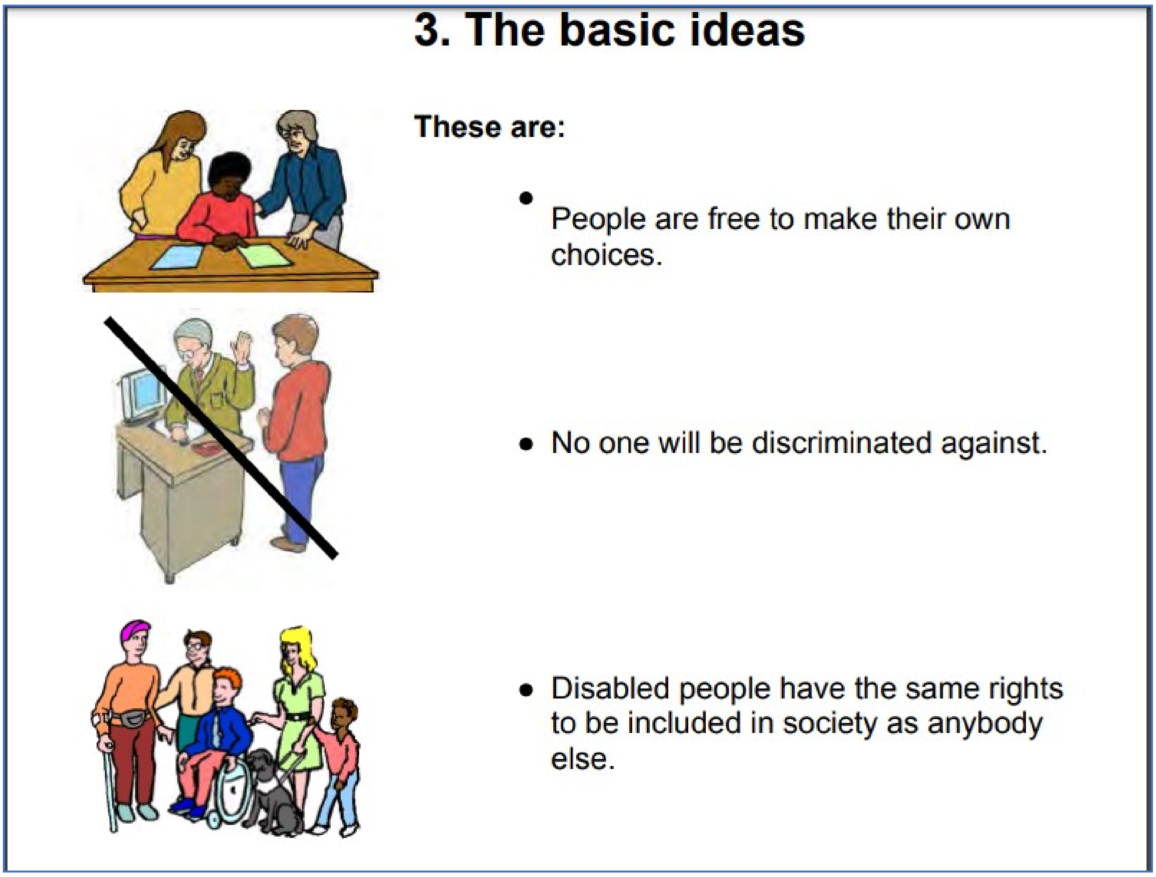

Figure 78: Imagine of the easy-to-read version of the Convention on the Rights of Persons with Disabilities (CRPD), officially translated as international agreement on the rights of disabled people.

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The above images show the same article of the Convention (article number 3) in its original version (Figure 77) and in its easy-to-read version (Figure 78).

The first thing we can note is that in the easy-to-read version, the centered text is substituted by a right aligned one, near which there are images exemplifying the words.

Characters are larger and their contrast higher. Times New Roman characters has been changed in Arial. The original list ordered with lowercase italics letters is replaced by bullet points one.

The word "Article", a technical one with a specific meaning in law and representing an abstract concept has been eliminated.

"General" and "principles", again, two words expressing abstractions and, in the case of "principles" not common (not in everyday life) are replaced by "basic" and "ideas" more common and direct. Repetitions ("General principles" in the title and the first sentence "The principles of the present Convention shall be") are avoided ("These are" referred to "The basic ideas" of the title).

"Respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons" becomes "People are free to make their own choices" eliding the redundant and abstract introductive sentence and going straight to the point. In this way the main information is communicated, the sentence is shorter and simpler, with less time to spend in reading and more for understanding, abstract concepts (respect, independence, dignity, autonomy) are avoided.

When designing information accessible to people with intellectual disabilities and easy-to-read use is included, though some agencies exist (as the concept is now spreading among the general population in order to simplify technical manuals or bureaucratic procedures), it is highly recommended to involve and consult people with intellectual disabilities themselves.

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Topic 5: Use of Augmented Reality in Self-Advocacy Training

Training and practice of self-advocacy skills, as in the above examples, can be successfully enhanced through the use of role-playing and simulations.

Given the fact that we have hypothesised also the possibility that there is no chance to perform group training and that the advantages of role-playing and simulation are related to the possibility to repeatedly enact the practice of certain skills in some contexts simulated in a safe space (i.e., the training group one), we think that it would be interesting to investigate the possibility of practicing role-playing through the use of new technologies.

This is not a very new research field as some research has been done about the use of new technologies in learning contexts also linked to the teaching of people with intellectual disabilities.

What is quite new and yet not well explored is the application of augmented reality to training and even more to self-advocacy training.

This is because previous research focused more on other kinds of new technologies as AR was too expensive and only in the last decade have AR devices have become cheaper and portable.

As now, most of the findings indicate that AR can be helpful in educational settings also for people with intellectual disabilities, improving motivation. Different results are presented about the application of AR in work settings, where sometimes it results in a reduction of time required to complete some tasks while, on the contrary, sometimes the research concludes that the use of AR by people with intellectual disabilities is too demanding when in combination with physical task to be performed.

From the point of view of AR application to role-playing for people with intellectual disabilities, there is a lack in the research but encouraging results come from research in the field of educational role-playing addressed to non-disabled students especially for what pertains some self-advocacy central skills such as problem solving.

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Topic 6: Technology Acceptance

When talking about technology acceptance, we are talking about a huge issue.

Technology is, in fact, pervasive in everyday life and every one of us uses - or has to deal with - a myriad of different technologies and technological products and services.

Technology is so very important for the world today that there is a whole area of research that is devoted to technology acceptance.

Moreover, when talking about technologies in relation to people with disabilities and older people, we have to take into account that there is a whole field of it is addressed to them, the so called assistive technologies (also with the more and more less used adaptive technology, that is in fact a kind of assistive technology).

Even if the definition “assistive technology” is quite recent (dating back to the 1980s) and the term usage has exploded and spread all over the world in the last decades, basic assistive technology solutions are ancient and also very common (e.g., sticks, glasses, wheelchairs) and some attitudes towards them are well-known.

Starting from considering some observations and research made in these two different fields and then linking them to some newer research about the so-called new technologies we would obtain some useful indications to be taken into account for our purposes.

Basically, we have to consider that most of the research on technology acceptance focuses on the attitudes of the users towards the technology, highlighting how these are influenced by the perceived usefulness and by the ease of use.

These two characteristics are mentioned and their importance underlined also in more specific research related to the use of prostheses.

Especially when talking about assistive technology solutions, we can have different attitudes: the user has a rejection of his/her condition which is transferred to the aid itself that becomes a kind of symbol of it or the user suffers from social stigma associated to the disability and to the technological solution itself. Sometimes, on the contrary, the user can subvert this order and make the aid a positive, identity symbol (it is the example of some activists or movements for the right of people with disabilities).

More, users can have very high expectations about the assistive technology solution and so be disappointed and dissatisfied by the reality and refuse the solution.

So, when selecting the various solutions, we have to take into account the need to properly explain and train the users, in order to create realistic expectation about the improvement the solution will bring to the users’ lives.

We have also to take into account the users’ personality and possible previous experience with assistive technologies.

On the other hand, we have to consider the environment in which the solution will be used in order to choose the most appropriate ones.

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Some research in the field of assistive technologies shows that in the presence of two possibly equivalent solutions, users with intellectual disabilities prefer the most efficient (that in this case is also the easiest to use), as in the ordinary pattern of choice identified by common research studies, even if this is a noncommercial one (which could be perceived as a stigmatized solutions as marked "for people with a disability").

For our purposes, the choice to recur to mainstream technological devices and solutions bring a considerable advantage in avoiding the rejection of them.

On the one hand, they are not something that is seen as negatively marked, but on the contrary some of these technological aids are quite fashionable, such as smartphones, smartwatches, apps and so on.

On the other hand, other solutions such as augmented reality or virtual reality are perceived in a positive way, especially by young people and, on the contrary, some research studies pointed out the opposite risk, when these are used in educational contexts, that is that the real interest of users could be in the technology alone and not in the contents.

Beyond the positive (or negative) attitudes of the users, it is fundamental that users are aware of the aims for the use of these devices and solutions, both if they have to operate something or not.

It is, for example, important that a person knows if the watch they are wearing can locate them even if the watch cannot be operated by the user. In this case, if the person can feel uncomfortable because for example, they feel like they are being controlled, it is necessary to explain that this kind control is needed to give the user more freedom. For example, to walk alone or that it is a mean of safety, highlighting the possible positive aspects and outcomes of the proposed solution.

Taking into real consideration the opinions of the users, we can surely find a solution that best fits their needs and also desires.

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Topic 7: Self-Advocacy Scenarios

In the following, we provide some scenarios in which self-advocacy skills can be displayed with indications meant to be given to people with intellectual disabilities in order to cope with these situations.

7.1: Travelling Alone

People with intellectual disabilities could like the idea to use public transportation alone. To do this, provide them with some useful general indications.

First of all, they have to know where they come from and where they want to go.

In this way, they can find information even before leaving their house, through internet or information sheets.

If it is the first time they will travel alone or on a certain route they can check the travel in advance, at home or at the bus stop, consulting information like maps or asking someone they trust. If they are in a station, they can ask to the information point or to the ticket office. If they have difficulties to talk, let them know that they can ask also using the map pointing where they want to arrive.

If possible, suggest them to take note of the route, numbers of bus and possible place where they would have to get off to take another bus.

They have to know that to use bus, underground, train they have to pay or be otherwise entitled to travel, though a card or a disability card where this is the case.
If they have a card or a season trip, specify that they don't have to pay but they have to remember to take it with them before they leave.

Explain to them that if they are in a difficult situation or are not sure about something or they got lost, they can ask someone for help, preferably a person working for the transport company or for the community and that they are usually recognizable because they wear a uniform and/or a badge. A simple example is the bus driver.

Suggest the idea that for the first time they can be accompanied on the new route and in any case suggest to them, as a reassurance, that they can use some technological devices and tools to be traced. Explain to them that it is not a matter of distrust of them but a resource to be used in case of problems.

Imagine situations they are likely to face during their trip and work on them. Organise simulations, role-plays or write down instructions for them to be prepared to manage these situations.

A classic scenario is that of an overcrowded bus with people pushing each other or blocking the doors. Prepare the person to this possibility and explore possible appropriate reactions or solutions such as talk in a polite, calm but firm and secure manner and ask for space to reach the exit.

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Also, modify the scenario to foster people’s reflection about the appropriate reaction to slightly different contexts.
Encourage the person to think if self-advocacy can be always applied or if in some cases it is useless or inappropriate.

For example, if the person is uncomfortable because of the physical pressure of other persons around them, let the person think if there is space enough to modify the situation so that their complaints make sense or if it is the case to bear the situation and resist until it betters or they get off or if they want to get off earlier and then wait for a less crowded bus.

Let the person know that self-advocacy in this case can be differed i.e., the person later can address a complaint to the bus company, through various channels you can show them (the complaint office, by mails, email, etc).

Prepare the person to less expected but common situations such as:

Someone on the bus or at the station is asking for money: explain that it is not an obligation and that if the person can decide to help, they can give some change or 1 or 2 euro. If the person asking for money continues to ask or asks for more, explain that they can reaffirm their decision, always in a kind way and, if the case, can walk away and/or ask for help, even remembering that it is preferable to refer to a someone with a uniform i.e., someone working for the company or for the community.

Someone getting stolen: in this case, the person with intellectual disabilities have to know that they can use also a higher tone of voice as this is an emergency situation, in which if they can they should intervene. Explain the person that if they are afraid to do directly, they can involve someone nearby or go to the bus driver or to another kind of officer. At the same time, always tell the person to consider safeness as a priority so that if there is a risk it is better that they intervene but stay safe.

The same goes in decision to self-advocate or not. It is not uncommon on a public bus to meet someone who is behaving in an aggressive manner. Teach the person that in this case, if they are feeling unease, they have to evaluate if it is the case to ask the person to stop or, especially if there are no other people who can help, it is better to go to the bus driver or to get off and wait for another bus as the situation is a possible danger that threaten their safety.

7.2: In the Supermarket

People with intellectual disabilities can be perfectly able to go to a shop or to the supermarket.

You have to provide indications about what is indispensable to them to do so and foresee possible situations which they can find themselves in, in order to provide them with the appropriate instructions to overcome possible difficulties.

First of all, they have to be sure to take money with them. Preferably, they should make a shopping list, not only as a means to remember to take everything they need but also to have an idea of how much they will spend and take the appropriate sum of money with them.

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They can help them with a supermarket flyer to know the prices in advance but also to have a list with images on that can help them recognise or ask for a product.

Explain them that if they want, they can use a cart, especially if they are going to buy many things, and that often to take the cart they need a coin to be inserted in a slot to take the cart. Tell them that after they use the cart, they can retake the coin from the slot. Remind them that even if it is funny, it is not OK to use the cart to play, like running through the supermarket's aisles or jumping on it. Explain them that is forbidden and, most of all, dangerous as they can hurt themselves, someone else or cause damages to the shop.

Explain them that, beyond the possible flyer, prices must be under the products on the shelves and that the price must be clearly visible and expressed. If they have a flyer indicating a different price, maybe the flyer is an old one and that they should check the validity period of the flyer on it (usually it written in very little characters). If the person has doubts about prices or other things in the supermarket, they can ask to people working there, who can be recognised by the uniform. Otherwise, they can ask to another shopper.

When someone is weighing food, often you need less than what the employee at the desk is giving you. People with intellectual disabilities must know that they can claim the right amount they have asked for, even if the workers or other shoppers grumble.

All these requests and claims must be done using an appropriate tone of voice, calm and not accusatory and the same goes for the phrase to be used that can be something like: "Excuse me, probably we didn't understand each other, I asked you for…" or "Maybe there is an error". If the employee gets angry or feel accused just reiterate your request also specifying that you are not accusing anyone.

When in the cashier line, remind them to respect the queue and that everyone has to do the same. If someone jumps the queue, the self-advocate can talk with the person themselves and/or ask the supermarket employer to intervene. Remind them that supermarket is camera monitored, especially in the area of the cash registers so that if the self-advocate is sure of what they are saying they can go on as they have a clear and easy means to have the claims verified.

If when the person is paying, they realise that they don't have enough money, it is better to say it before the bill is complete so to avoid problem with the cash routine. There is no need to be ashamed as it happens to a lot of people and cashiers are quite used to this. So, the person has just to check and if the case, ask the cashier to leave something. Another possibility is to ask to go to get the lacking money and leave the shopping at the supermarket.

Explain that there can be errors in computation at the cashier and that these errors are rarely because of bad intentions. Anyway, they have the right to ask for clarifications about the prices and can have their money back if there is an error.

People have to check the receipt during the computation or when leaving the supermarket so that if there is a problem with the bill, they can immediately ask for explanations.

Sometimes, it happens that when you are leaving the supermarket the anti-theft alarm rings. Explain to your trainee that in most of the cases, there is a malfunction in the system or the cashier left a security tag on an item, and they have nothing to fear because they have the receipt that showing everything they have bought and paid for.

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It is the duty and right of the supermarket staff to check, so the person must let them do their work, even if they ask to look at your bag. If you feel unsecure or embarrassed remember that you can ask to go in an office and also to call someone you trust to help you cope with the situation.

When you enter or leave the supermarket or go to get the cart, often you can meet someone asking for money or for the coin in the cart. The person with intellectual disabilities must be aware that it is his/her own free choice to give money or not, and you can suggest that some change or 1 or 2 euro is enough. Another important thing to explain them is that once they have given the answer, money or not, the person asking has no right to insist.

When leaving the supermarket, you can be asked if you need help with the bags. Explain to the person that even if it can seem very kind, it can be a way to ask some money. Explain that often the person helping may expect some money in turn and the abovementioned sums are acceptable. Anyway, also in this case the person is free to refuse the help or not and also, having accepted the help, to refuse to give money, even if this can be seen as not very polite.

Just mention the possibility that the offer to help is a bigger scam aiming to steal the bags but this is very rare and the person can readily ask for help also screaming, as this is a case of emergency.

7.3: At School

When at school, students with intellectual disabilities can exert their self-advocacy skills in various ways.
When relating both to the general education teachers and to the special education teachers, people with disabilities have to be aware that they have the right to ask for changes (for example, regarding their position in the classroom), adjustments and assistive devices and technologies that can help them having better performances.

An important focus of research and practices is about the involvement of students with intellectual disabilities in their Individual Education Plan/Programme (IEP). An IEP is a kind of curriculum that under various names exists in most schools from various countries.

Very simple self-advocacy examples in a school setting are related to the expression of basic needs such as:

You have problem with being able to follow what is being explained because you are too far from the teacher or you cannot see the board very well. All you have to do is to raise your hand and explain the teacher your problem, proposing as a solution a nearer sit for you.

You are quite slow in writing or you cannot adjust your movement to use a tool or device (computer, chalk, and so on). Explain the teacher your problem and together try to find a solution. Remember that there are accommodations and assistive devices that are addressed to you and that they are full part of your right to education.

Beyond educational aspects, schools are social contexts where you can experience most common human feelings: you can be happy with your classmate or have problems with some of them, you can play with the others and sometimes arguments may arise. This is quite common. Remember

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that you have to be polite and kind to everybody and you can expect other people to do so, but anyway if something is giving you trouble you have the right to express what you think and feel about it. If someone is calling you names or is otherwise bullying you, you don't have to be afraid to react and ask them to stop. Teachers and other adults can help you with your problems, so don't hesitate to tell them if something is wrong.

If you think that reporting wrong or dangerous behaviours to teachers or adults is going to worsening the issues or get the other students more hostile towards you, remember that you are the one right and that probably most of the students will stay on your side.

7.4: At Work

As a worker, you have a series of right, and also duties, you have to refer to. Sometimes, nevertheless, these rights can be not respected but you have to stand for them. If there are serious issues you can also ask for someone interventions: labour unions, for example, aim at defending workers' rights.

More often, your troubles can be related to others' behaviours towards you often on the basis of mistakes and misunderstandings.

For example, someone can ask you to do a job you are not requested to or a job you haven't be trained for. In these cases, think if the person is in charge to assign you a task, if not, you can explain him/her that you have a coordinator or a supervisor or a superior you have to respond to and that if he/she wants she/he can talk to that person.

Sometimes, one of your colleagues asks you for a favour and asks you to do some work for them. This is quite normal and to a certain extent acceptable. If the thing continues for a long time or if this is taking time to do your job, you have to explain the person that you have to do your job and that everyone is paid to do their own job.

Remember that also in these cases, as in other contexts, there are people in charge to decide and solve problems you can appeal to.

One of them is the person you can ask to change your task if you don't like it and also to have a higher wage. Remember that you can ask and they have to answer, explaining in case why they can or cannot agree with your requests. Overall, remember that sometimes there are no conditions to have what you want and that this cannot depend on the person will.

7.5: At the Hospital

It can happen that you have to go to the hospital, to undergo some examinations or because of other reasons.

You don't have to be afraid of doctors as they are there to help people, included you.

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Often, doctors can use a difficult language and even not talk to you directly. You can ask them both to talk with you and to use a simpler language. These are both your rights as the right to understand what they are going to do you, what medicines they will use, and so on. Other things you can ask for is to have a written report and also a copy of your medical record.

When you are in an hospital, usually there is a lot of people and a lot of rooms, aisles and halls. You can ask someone with a uniform (doctors, nurses) to help you if you get lost or need more indications to reach what you are looking for. Remember that usually near the entrance there is an info point where you can ask information also about indications to go somewhere.

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Summary:

Self-advocacy is an ability made up of various skills, related both to the individual dimension and to the social context in which a person lives.

In a few words, self-advocacy means **to be able and willing to defend one’s rights and beliefs, and express one’s will and needs, without being aggressive or fearful. It means to become an active and engaged member of the society**.

Basic components of self-advocacy are: **self-awareness, communication skills, leadership, and the knowledge of rights and responsibilities**.

Working on these basic features, training and reinforcing their subcomponents, **people with disabilities, also those with intellectual ones, can be empowered and gain an increased control over their lives, their roles, and their needs and desires**.

This process would lead to more autonomy and independence.

Workers in the field of care and assistance must be aware of the techniques of self-advocacy and help people with intellectual disabilities by providing them with guidance and information.

Nevertheless, they have to respect the beliefs of people with intellectual disabilities and try to put themselves in an equal relationship.

Nowadays, technological progress seems to be able to provide promising means in helping people with disabilities to live more independently and at the same time in a safe way. It is also a very important means of education and information of people, even if, especially when using the Internet, people have to be aware that there are some issues that may arise, both in terms of reliability of information and with regards to inappropriate content. Not only can people with intellectual disabilities discreetly be supervised when navigating on the web, but also technological aids are becoming more and more available in this sense, starting from the standard means of safe navigation provided in smartphones and computers up to the increasing availability of digital tools to verify information reliability.

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Learning Evaluation:

A. Self-Assessment Questions:

Question 1 – Which of the following sentences is false?

a. Self-advocacy is a political issue.
b. Only people able to speak can perform self-advocacy.
c. Self-advocacy is about expressing one's needs.
d. Self-advocacy isn't an innate ability.
e. Self-advocacy is related to both individuals and the society.

Question 2 – Being assertive means…

a. imposing one's will over the others.
b. saying yes.
c. being aggressive.
d. being able to express in a calm and positive way.
e. obtaining what one wants belittling the others' positions.

Question 3 – People with intellectual disabilities have…

a. to not know their rights, which are protected.
b. no rights.
c. the right to know their rights.
d. no word in their rights.
e. no possibility to understand their rights.

Question 4 – One of the possible outcomes of self-advocacy-related activities is empowerment, which according to Rappaport means that…

a. people with intellectual disabilities gain higher wages than before.
b. people with intellectual disabilities become stronger, so that they can perform better physically.
c. people with intellectual disabilities are given special benefits.
d. people with intellectual disabilities understand difficult things.
e. people with intellectual disabilities gain mastery over various aspects of their lives.

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Question 5 – Accessible information for people with intellectual disabilities means…

a. information written in Braille characters.
b. to have the right to lower prices of books.
c. that information must be provided vocally, as people with intellectual disabilities cannot read.
d. that information must not be accompanied by photos and pictures, as they are distracting.
e. that information must be provided through simple language and brief sentences, avoiding as much as possible abstract or superfluous concepts.

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B. Activities

Activity 1 – Agreement

The participants are requested to create an agreement (or a contract to start getting introduced to a more professional perspective).

This activity can be implemented at the beginning of a meeting if you would like to take advantage of it for creating an agreement on the rules of the group.

Explain to them that an agreement is made by all the people involved and ask them to provide ideas about a topic, in our example about the rules of the group.

All the participants should express in turn at least one idea about how the group should work.

Activity 2 – Strengths and Weaknesses

Strengths and weaknesses are fundamental for the development of self-advocacy skills, as they are among the elements rendering self-awareness one of the prerequisites for self-advocacy activities and one of the characteristics that helps a person develop and improve.

In addition to any external assessment (i.e., by a specialist), we need to have an idea of what the person thinks their main strengths and weaknesses are.

The activity proposed is very simple and can be performed on an individual basis or as a group activity.

Ask the participants to write down or express what they like and what they think they are good at, and also what they dislike and what they think they cannot do.

The same can be also done in a group, especially during first meetings, as this activity can also help participants begin to get to know each other. In that case, it is advisable to divide the participants into pairs and ask them to talk to each other about themselves. If that will be the very first meeting of the group, they can also provide information about their life, such as their family, the place in which you live, their pets and so on. Each member of the pair should talk for around 5 minutes and discussion in pairs should last 10 minutes. Then, each person will introduce their discussant to the others.

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UNIT 3. Social Networks’ Development

Aim:

Social networking sites are popular online communication forms among people of different ages, professions, abilities, and interests. Yet, little is known about Persons With Disabilities (PWD) activities on these sites and how their networks of “friends” relate to their other online and offline networks.

In this Unit, professionals working with PWD get knowledge and learn methods on how to enable and encourage PWD to use E-social networks, in order to help them stay connected with friends, family and colleagues by using ICT.

Learning Outcomes:

After completing the course, the learner will be in a position to:

In terms of **knowledge**:

Theoretical Knowledge on Social Networks:

- ✓ Define the concepts and principles of the Natural Social Networks.
- ✓ Interpret the Philosophy and Values of Social Networks.
- ✓ Set a goal for the development of social networks for PWD.
- ✓ Define the roles of the persons involved in Social Networks.
- ✓ Define the Liaisons and their Role in the Network.
- ✓ Interpret the concept of the Circle of Friends.
- ✓ Illustrate the procedures for the creation and maintenance of social networks.

Theoretical Knowledge on E- Social Networks:

- ✓ Infer how to adapt the existing E-communication tools to the needs of PWD.
- ✓ List the methods and tools of how to teach the PWD to use E-communication tools.
- ✓ Compare the difference between digital and real social networks.

Factual Knowledge on Social Networks:

- ✓ Define the term “Social Network”.
- ✓ Support the PWD on social networks.
- ✓ Help maximize the Social Network of a PWD.
- ✓ Model what the key roles of PWD involved in social networks are.
- ✓ Identify the benefits that PWD and their families reap from the existence of a social network.

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- ✓ Adopt the techniques on how to help PWD to be involved in maintaining a Social Network.

Factual Knowledge on E-Social Networks:

- ✓ Interpret one-way digital social interaction.
- ✓ Name the key trends in how digital social relationships can reflect real social networks.
- ✓ List the basic techniques to help PWD to enjoy digital social networking.
- ✓ List and use methods that help PWD maintain digital social connections.
- ✓ Customize security measures for the personal information of PWD.
- ✓ Compare appropriate and inappropriate actions in digital social networks (language, attitude etc.).
- ✓ Infer benefits and threats of digital social networks.

In terms of **skills:**

Cognitive Skills on E-Social Networks:

- ✓ Discover the main rules of a Social Network.
- ✓ Distinguish the characteristics, needs, and wishes of PWD getting involved in social networks.
- ✓ Distinguish the main strategies to help PWD getting involved in social networks.

Cognitive Skills on E-Social Networks:

- ✓ Evaluate safety of each PWD on the Social Network.
- ✓ Analyse common traps.
- ✓ Categorize good and bad behaviour examples on the net.
- ✓ Help the PWD to defend his/her identity online.
- ✓ Develop criteria for the Etic in the net for each individual service user.
- ✓ Help the PWD to predict mobbing in the net.

Practical Skills on Social Networks:

- ✓ Help PWD to design social networks.
- ✓ Support the Social Network of PWD's by employing the appropriate techniques.
- ✓ Solve any potential difficulties faced while maintaining a Social Network supportive of PWD.

Practical Skills on E-Social Networks:

- ✓ Compose a step-by-step E2R guide/animated movies for people with intellectual disabilities on how to use existing social networks.
- ✓ Design E-games to get the relevant skills.
- ✓ Help PWD to reduce his/her Social Isolation.

In terms of **attitudes:**

- ✓ Evaluate the needs, wishes, and abilities of PWD.
- ✓ Plan procedures for the creation and maintenance of social networks.

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- ✓ Compile a list with the actions that a Social Network member can take.
- ✓ Compile a list that contains the potential difficulties that may be encountered as proceeding with the creation of a Social Network for PWD.

Topics:

- E- Social Networks Friendly for PWD (Persons with Disabilities)
- The Practical Methods and Tools to Get Involved in E- Social Networks
- Safety and Ethic on E-Social Networks
- Technological Aids that Could Assist in Conventional Social Networks

Key Words:

• E-social network • Types • Roles • Involvement • Quantity and quality • Experience • Disability online • Accessibility • Technology	• Methods • Tools • Safety • Ethic • Technological aid • Well-being • Cyber bullying • Social media

Introduction:

A social network is a space that allows people with similar interests to come together and share information, common interests, needs, etc. Social networking and the ability to communicate are important skills we need in life. Almost everything we do, such as asking for food and drink, solving problems, expressing opinions, making friends, and having fun, is vital for everyone. A lot in our lives depends on our ability to communicate with each other and build and maintain social networks. Users of social networks voluntarily connect with each other to share something in common. Social networks can be face to face or online.

Social networking sites are popular online communication forms among people of different ages, professions, abilities, interests. Yet little is known about PWD's activities on these sites and how their networks of "friends" relate to their other online and offline networks.
In this module, professionals working with PWD will learn how to enable and encourage PWD to use the E- social network.

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In addition, the development of social networks requires practical rather than theoretical skills.

This social networking module is for professionals working with PWD (person with disabilities).

The content of the module is designed so that professionals can improve their knowledge and learn more in this field and how to effectively assist PWD.

The model corresponds to actual needs of professionals and their target group.

It is particularly important for disability service organizations to develop effective digital disability inclusion strategies to combat widespread social exclusion among people with disabilities.

Professionals working with PWD need tools and methods to enable PWD to perceive, interact, understand, and navigate tools of the social networks and services and products and that they can contribute equally without barriers.

Figure 79: Photo Irma Morkuckienė

Preparation for the training

Participants should put their mobile phones in the box before the training begins.

Rule – do not check the phone during training and even during a break. This is necessary to achieve the goals of this training.

Participants in the training are divided into groups.

Group size: 3-5 participants.

Each group gets a situation. In each situation a particular PWD is described. Description of his/her hobbies, motivations, and opportunities to participate in face-to-face social networks and E-social networks.

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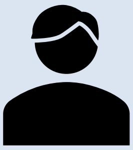
The group examines the situation and tries to imagine that the person described in the situation is a user of social services, and the group of professionals needs to know him well and help him to integrate using social networks.

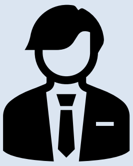
Situation No 1



Name: MAIK
Gender: Male
Age: 31
Disability: Hearing Impairment and Intellectual Disability
Occupation: No **occupation** (spends time at home)

Hobby: Crosswords
Role in e-social network: Passive
Summary: He has no close friends. He has a dog and loves to walk him. Tried to connect to social networks but failed, so now avoids using social networks. It is difficult to establish a relationship to him. Maik does not follow agreements. Loves to solve crossword puzzles. Cannot hear, so does not watch movies.
Social exclusion: has no social circles, feels depressed and most of the time angry.

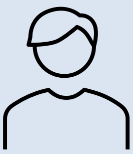
Situation No 2



Name: TOM
Gender: Male
Age: 36
Disability: Intellectual Disability
Occupation: Social care service user

Hobby: Technology
Role in e-social network: Active
Summary: Tom has a lot of friends. Uses all possible social networks. He often meets new people but does not maintain long-term relationships. Loves cars very much but has no driving license. He cannot read and write but communicates well with voice messages. He pushes his friends to behave the way he likes. Tom does not really care about other peoples' opinions and needs. He doesn't respect the privacy of others, so after a while, friends turn away from him.
Social exclusion: is unable to create a permanent circle of friends, so is frustrated and constantly looking for new contacts and face the risks.

Situation No 3



Name: KARL
Gender: Male
Age: 26
Disability: Asperger's syndrome, Speech and language disorder
Occupation: Social care service user

Hobby: Technology
Role in e-social network: Neutral

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Summary: He has no friends, but he does not feel bad about it. He never expresses his opinion even with the people he is meeting every day. He enjoys listening to audio books. Karl is interested in space technology. He can explore space information for hours upon hours. As a result, he may not sleep all night, because he is involved in his research. He would like to learn more about space, and to meet people interested in this topic as well. He has one social network account, but there is no information about him.
Social exclusion: has no ability to create a circle of people with the same interests.

Situation No 4.

Name: MONICA
Gender: Female
Age: 29
Disability: Complex disability *(Physical disability and Intellectual Disability)*
Occupation: Works non-full time
Hobby: Active leisure
Role in e-social network: Leader
Summary: She has many friends and many interest groups. She brings together many people around her. She actively uses social networks to find new activities. She wants to try everything what is possible. Monica is active not only in social networks, but also in community life. She encourages other people to follow her. She keeps her commitments. She is open-minded and most interested in any active lifestyle.
Social exclusion: because of physical disability and environmental barriers suffers lack of face-to-face contact.

Situation No 5.

Name: LORA
Gender: Female
Age: 33
Disability: Down syndrome
Occupation: No occupation (spends time at home)

Hobby: Communication
Role in e-social network: Participant
Summary: She wants to find a partner. Lora has more than 5 social accounts. She uses social networks for only one reason - dating. She has unconditional trust in the people she meets online. She often meets a young man without knowing him better in advance. As a result, she often experiences financial violence and sexual exploitation, but does not identify it as a threat. If she likes a young man, she becomes obsessive and constantly sends messages.
Social exclusion: spend time at home every day, has no circle of friends.

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Topic 1: E-Social Networks Friendly for PWD (Persons With Disabilities)

Having friendships and interpersonal social connections is a normal and expected necessity of life that enhances individual well-being. However, many people with disabilities are socially excluded and out of the mainstream society. Living with a disability can be lonely and challenging.

Digital platforms, such as social network applications, present a means for person with disabilities to integrate into society. The benefits derived from social interactions reduce the sense of social exclusion of person with disabilities, offer many positive effects on overall psychological well-being and enhance a sense of addiction that promotes self-confidence.

Individuals with various forms of disabilities have a fundamental right like anyone else to build social networks and to participate in social networks. However, they need targeted help. The necessary assistance should be provided by the supporter of the disabled person.

This module also provides information about legislation that aims to ban discrimination against the disabled.

Figure 80: Photo Eglė Gudžinskienė

1.1: Social Network and E-social Network – Differences and Similarities

Social networks connect us to other people. Some connections are stronger, such as family and friends. Some connections are more distant, such as neighbours or people in the workplace.

Research has long supported the idea that strong social ties strengthen people’s mental health.

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Are the different forms of social networking equal? Does digital communication with friends or family have the same power as face-to-face social interaction?

Scientists are trying to answer this question. The rise of the Internet and digital means broaden social circles. Online ties supplement face-to-face connection.

E-social network is a person's connection to other people through social media (such as Facebook, Twitter, Linked In, and Instagram).

Face-to-face social network is a network of individuals (such as friends, acquaintances, and co-workers) connected by interpersonal relationships.

E-social network, like a face-to-face social network, can have a social purpose, a business purpose, or both.

The advantages and disadvantages of face-to-face social network and E-social network:

Advantages

- Social networking gives a chance to connect with people around the world. It's easy to become someone's "friend" or "follower" It's easy to stay in touch with family, old high school friends, and more. It's easy to even connect with people from places you've never seen or heard.
- The communication tools are affordable. It's easy to stay connected to social networks using your smartphone, your computer - the tools everyone has.
- Information happens in real-time on social networks. Information and communication are available 24/7.
- Being on a social network is a lot of fun. The average person spends between 35 to 45 minutes every day on their favourite social networks. Humans are naturally social creatures, so it feels satisfying to have likes, hearts, or comments left on a posit. It is possible to create friendly conversations in the comfort of home while seeing what everyone is doing without needing to ask them.
- Social network is a tool to learn. About 3 out of every 5 people say that they use social networks to discuss different topics, share experiences, and learn from each other.
- Social networks help shy or socially isolated people to connect with others. About 1 in 4 people say their social networking experience has made them feel less shy when interacting with others in real life. An online resource gives people the opportunity to feel more comfortable, become vocal, and practice communicating with other people.
- The socially isolated people (elderly, disabled) can feel more connected to society because of social media. They could talk to their family, friends, see pictures and videos.

Disadvantages

- Social networks host too much information. There are millions (and sometimes billions) of people on a social platform. Due to the blizzard of social networking data, it becomes a challenge to stay in touch with people.

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- There are privacy issues to consider with social networks. Because there is so much data sharing happening with the modern social network, the amount of privacy that we have for the average person is shrinking a little bit every day.
- Cyberbullying can be a significant issue. Negative behaviours can worsen online when compared with face-to -face situations because bullies feel like they can be anonymous when sitting behind a screen or using a smartphone. In extreme cases, the bullying and negative comments that occur over social networking can lead to anxiety, depression-like symptoms, and high levels of stress. Prevention of cyberbullying should be included in state anti-bullying policies, alongside broader concepts such as digital citizenship, online peer support for victims, and how an electronic bystander might appropriately intervene.
- Socially isolated people (elderly, disabled) may still not be ready to use social media, as they may lack knowledge and skills.
- Some people substitute online interactions for their offline relationships. Increasingly, online chats are replacing face-to-face chats, and this is reducing social skills. Because of this shortcoming, some critics of social networking would say that these activities encourage anti-social behaviour more than they encourage new connections.
- Social networking "stealing" time and attention. Do you check your phone when you wake up in the morning? How often do you scroll through Facebook or Instagram? There are some ways that you can limit this disadvantage. Start by turning off notifications on your phone and in your browser. Talk with people instead of pulling out a device to chat on an app. Give yourself specific times during the day where you check on your profile and news feed instead of going to it multiple times per day.
- Social media can disrupt the normal schedule across the day. A long session on social networks can distract you from the need to go to bed or eat. The spectrum of blue light can be stimulating, the danger is that it can lead you to think more about what other people are doing than to try to relax.
- Using social networking all of the time can lead to a sedentary lifestyle. Because social networking typically happens on a mobile device or a computer, it can promote the habit of sitting down in a single spot for too long during the day. If you're using social media for 70 minutes every day in a seated position, then this habit can start to create changes that lead you toward a sedentary lifestyle.
- Social networking can spread false or unreliable information quickly. The problem is that there tends to be a lack of fact verification before the sharing process happens. News items that contain inaccuracies spread six times faster than articles that contain the truth. Fake news items receive more shares and retweets than true stories. It is up to each of us to verify the information that we share to avoid this disadvantage.
- The use of social networking is correlated with brain and personality disorders. Research finds that the use of social networking sites creates a significant increase in depression and depression-like symptoms. The addictive qualities of these platforms can lead to an enhancement or increase in narcissistic behaviours and personality traits. It may lead to hyperactivity behaviours, resistance to authority figures, and general inattention as well.
- It can be more difficult to find a job with your social media presence. Not only can you lose a job because of what you decide to share on social networks, but you can also find it more challenging to be offered a position in the first place. Job recruiters and human resource managers say that references to illegal drugs, sexualized content, poor grammar and

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spelling, and profanity all have a significantly negative impact on their perspective of a potential recruit. Firearms and alcohol are potential red flags on a profile as well. Up to 55% of recruiters today say that they consider hiring an applicant based on what they can see of their social media activities.

Summary: Social networking gives us an opportunity to quickly disseminate essential information to the public. We can use social media to disarm social stigmas. It helps us to stay connected with each other, learn about current events, and share the good things about our lives.

The pros and cons of social networking also show us that it can be used to spread hate and bully others. There are about 10,000 tweets every day which contains racial slurs. Social networking can also lead to social isolation. That's why we must make healthy choices when using this technology.

Social networking can be used for good just as easily as it can be used to harm others.

Task for participants (Team task):

To visualize the social network of the PWD described in the situation:

- Face-to-face social network
- E-social network

Highlight the advantages and disadvantages of face-to-face social network and E-social network.

Present findings and observations to other groups.

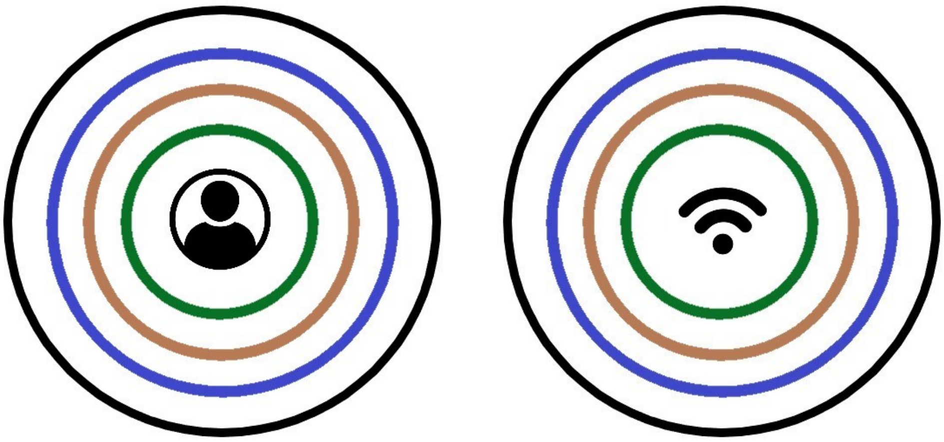

Figure 81: Social network

Summary: On a separate card (1.1) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

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Figure 82: Photo Eglė Gudžinskienė

1.2: TYPES of E-Social Networks

The primary goal of social networks is to help you connect with people, build communities and groups, share ideas, interests, and information.

With so many social networking channels and types out on the world wide web, it can be difficult to choose what works best for your client. To find out, the most important and first step is to identify the customer's needs.

The most common types of social networking:

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- Social audio platforms and formats.
  - Examples: Clubhouse, Twitter Spaces, Spotify
  - Used for: Listening to live conversations on specific topics.
- Video social media platforms and formats
  - Examples: YouTube, TikTok, Instagram Stories and Reels, Facebook Watch
  - Used for: Watching videos in short and long formats.
- Disappearing content formats
  - Examples: Snapchat, Instagram Stories, Facebook Stories, LinkedIn Stories
  - Used for: Sending ephemeral messages privately and publishing timely, in-the-moment content for all of your followers to view for up to 24 hours.
- Discussion forums
  - Examples: Reddit, Quora
  - Used for: Asking and answering questions, networking, forming communities around niche- and interest-based topics.
- Shoppable social media platforms and features
  - Examples: Pinterest Product Pins, Facebook Shops, Instagram Shops, TikTok, Shopify, Douyin, Taobao
  - Used for: Researching and purchasing products from brands directly through social media platforms.
- Social media live streams
  - Examples: Twitch, YouTube, Instagram Live Rooms, Facebook Live, TikTok
  - Used for: Broadcasting live video to many viewers. Live video streams can range from one person showing themselves and what they're doing on their screen to professionally organized panels with multiple speakers.
- Business social media platforms
  - Examples: LinkedIn, Twitter
  - Used for: Connecting with professionals in your industry or potential clients.
- Closed/private community social media platforms
  - Examples: Discourse, Slack, Facebook Groups
  - Used for: Creating communities, with the possibility of requiring registration or other screening measures for new members.
- Inspirational social media platforms
  - Examples: Pinterest, YouTube, Instagram, blogs
  - Used for: Searching for information and finding inspiration for anything from cooking to travel decorating to shopping and more.

Before using any social platform, you need to understand who's using it, and how. Here are the most important statistics you need to know to understand how and why people are using these social networks:

- Instagram Statistics
- Facebook Statistics

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- [Twitter Statistics]
- [YouTube Statistics]
- [Pinterest Statistics]
- [TikTok Statistics]

Task for participants (Individual task):

Examine the scheme in Figure 84 and sort the social media that are relevant / important to your user.

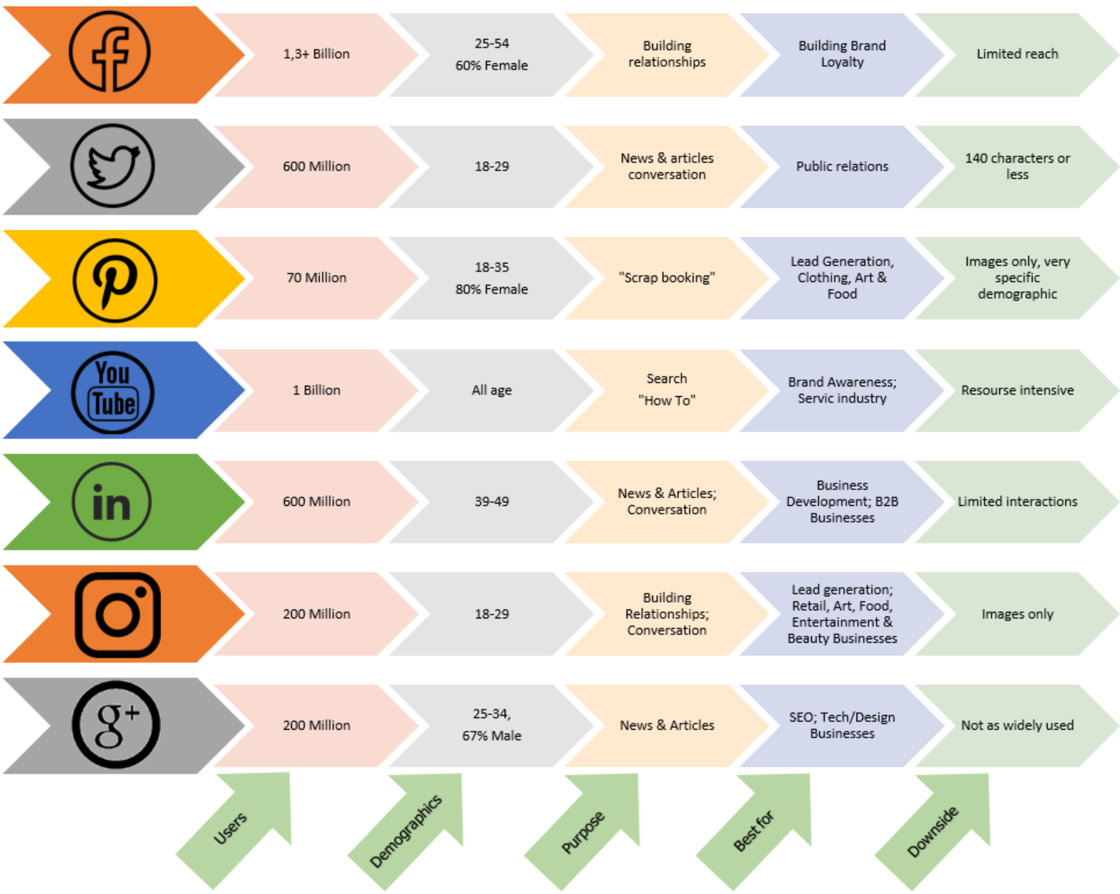

Figure 83: Social media most important to your user

Task for participants (Individual task):

Based on the current situation, select the appropriate social platforms or social networks for each E-social network type by completing this table.

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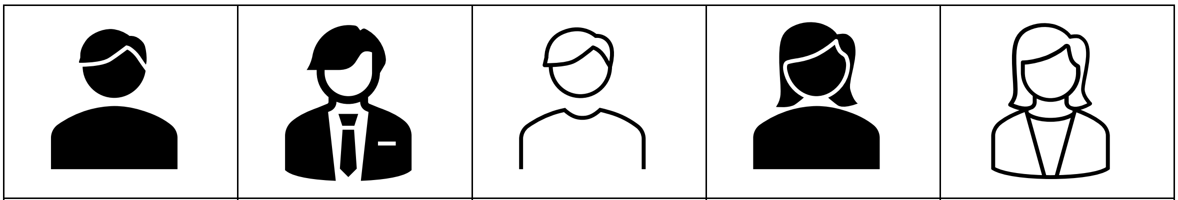

Maik	Tom	Karl	Monica	Lora

TYPE of social network	Suggested social networks or social platforms/ apps
Friends e-network.	
Hobby e-network.	
Interests e-network.	
Learning e-network.	
Entrepreneurship e-network.	
Professional e-network.	
E-health network.	
Self-help groups.	

Figure 84: Types of social network

Present findings and observations to your group.

Present individual findings for small target groups and find matches for small target groups.

Present findings and observations to other groups.

Summary: On a separate card (1.2) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

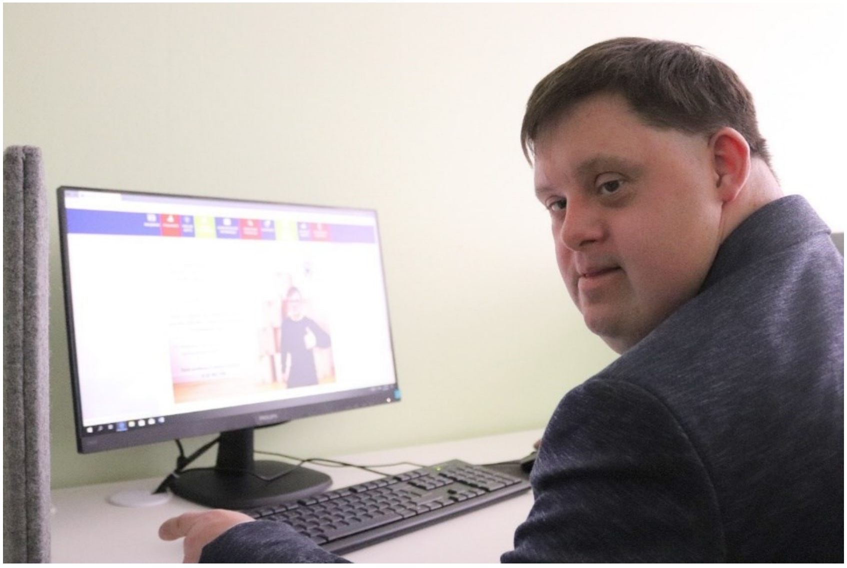

Figure 85: Photo Eglė Gudžinskienė

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1.3: ROLES in E-Social Networks

A social network consists of a set of actors and a set of relationships between them which describe certain patterns of communication. Most current networks are huge and difficult to analyse and visualize.

The three important roles were identified in social networking: “answer person”, “discussion person” and “reply person”.

- "Answer person" is to provide useful answers to other questions asked by members of the group.
- “Discussion person” is characterized by frequent reciprocal exchanges with a relatively high number of other participants.
- "Reply person” is responsible for creating new threads.

Based on individual behaviour patterns, two types of roles have been identified:

- “leaders” (spread knowledge and maintain the cohesiveness of the group) and
- “motivators” (keep the conversation going). Both roles were defined on the basis of their behaviour, conversations, and member relationships.

The third role, "chatters", was introduced, which refers to those who are engaged in a single discussion but rarely get involved in other discussions.

Roles such as "debaters", "spammers", and "conversationalists" can also be distinguished.

In the literature, many different sets of roles have been proposed, for example: “mainstream news source” (spreads information through the network); “celebrities” (public figures followed by many persons); “opinion leaders” (spread widely their opinions and exercise a big influence among their persons in the network). A negative role is performed by “social spammers” who use the social networks to disseminate malware or spread commercial spam messages.

Another set of roles is:

- “leaders” (who start tweeting, but do not follow others, but they can have many followers).
- “lurkers” (generally inactive, but occasionally follow some tweets); “spammers” (the unwanted tweeters, also called twammers).
- “close associates” (including friends, family members, relatives, colleagues, etc.).
- As can be seen, there is quite a large flexibility in defining sets of roles.

<u>Task for participants (Team task):</u>

The game "Get out of your comfort zone – put on another person's shoes”.

Roleplay tasks: Each group gets a situation, and each member of the group gets a role to play in a particular situation. The roles are chosen to be the opposite of the person's favourite role. For example, the active gets a passive role and the passive gets an active role; the positive gets a negative role and vice versa and so on. The task is to solve the situation using E- social networks.

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Possible situations, which usually provoke social integration of people:

- People will vote for D. Trump the next election.
- Vaccines can be dangerous and contain hazardous or poorly researched substances, creating risks that outweigh the benefits.
- Animals deserve similar or equal rights as human beings, free from captivity, abuse, or neglect.
- The dangers of climate change are exaggerated, and they are not connected to human activity.
- The theory of evolution that humans evolved from primates is not correct.
- Government corruption is a major problem in all countries. Most politicians become politicians for personal gain.

Topics for discussion:

- What roles can a person play in E-social networks?
- How did you feel about being given an unacceptable role?
- How can you achieve comfort in your role in social networks?
- How can you assist PWD to understand his/her role in E-social networks?

Summary: On a separate card (1.3), the participant writes what s/he has learned, re-learned, what discovery s/he has made for himself/herself.

Figure 86: Photo Irma Morkuckienė

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1.4: INVOLVEMENT in E-Network

Digital participation allows people to be involved in different societal activities at an unprecedented scale through the use of Information and Communication Technologies (ICT). Participation (online or offline) is a desirable goal, which contributes to inclusive societies both directly and through increased engagement.

These are some of points to successful network engagement.

Frequency is important — invite people to the meeting in person on a regular basis, and supplement those gatherings with virtual meetings and tools.

Allow other people to lead — motivate network participants to have a formal role in meetings, calls and conversations, elevate them and position them to be both contributors and advocates.

1-on-1 relationships matter — put time and effort into cultivating the 1-on-1 relationships that can often be key to bigger network.

Be clear about network member roles and benefits — strong networks are ones with engaged participants. And that can only happen if network members are clear on their role, expectations and the benefits of being a part of the network.

Let the network work for you — network could let you to meet new people with whom you don’t have prior contacts.

Cultivate the network for long-term engagement — this is important for the self-confidence and safety.

Be bold. Write, discuss and share experiences, topics and feelings. It strengthens the network and creates a “we” approach.

Know your network members and have a sense of their styles, interests and characteristics.

Build relationships through loyalty, expressions of value, and acknowledgement.

Task for participants (Team task):

The game “Find the information” with blind eyes: without assistance and with assistance.

The game is interactive. The learner must find objects around, according to the physical properties of the object. The properties of the objects are named by the leader.

Topics for discussion:

- Is a PWD motivated to have E-social networks in the situation?
- How important are E-social networks to him / her?
- What reasons motivate them and what stops them from participating in E- social networks?
- The main disorders and ways of PWD participation in E-social networks.
- How to motivate and assist PWD to become future-oriented?

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The game "Give me your phone":

Participants were asked to hand over their phones as soon as they arrive at the training. The phones are put in a box and make sounds continuously during the training. Participants are not allowed to check the phones.

Topics for discussion:

- What is my relationship towards my cell phone? How hard is it to stay away from it all day?
- How to avoid addiction or how to get out of addiction to social networks?
- How to help PWD not to become dependent on E-social networks?
- After the discussion, mobile phones are returned to the participants.

Designate a cell phone check break instead of a coffee break.

Summary: On a separate card (1.4) the participant writes what s/he has learned, re-learned, what discovery s/he has made for himself/herself.

Figure 87: Photo Irma Morkuckienė

1.5: DURATION and SUSTAINABILITY of E-Network

Sustainability is the quality of the sustainable. This is expressed in the Cambridge Dictionary: "the quality of being able to continue over a period of time". Sustainability is therefore the quality of temporal continuity, without altering its specific properties, and can be associated with multiple social phenomena.

As duration and sustainability of the social network depends on the quality of the network it is very important to pay attention is:

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- person's interests:
    - way he / she needs a network
- person's self-regulation:
    - expectations
    - wishes
    - autonomy
    - interactivity
    - needs
- external conditions:
    - accessibility
    - difficulties
    - influence
- impact:
    - benefit
    - feedback
    - satisfaction
    - changes
    - recognition

Task for participants (Team task):

Go back to task 1.1. - Visualization of the social circles of the PWD described in the situation: F2F social circles and E-social circles.

To determine the duration, change and sustainability of different social networks.

Topics for discussion:

- Which social networks are more important and more stable, F2F or online? Which ones need to be supported more often? Why?
- How to help PWD set priorities and develop E-social networks?

Summary: On a separate card (1.5) the participant writes what he she has learned, re-learned, what discovery he/she has made for himself/herself.

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Figure 88: Photo Irma Morkuckienė

1.6: QUANTITY AND QUALITY of E-Social Networks

This old question: the balance between high quantity or high quality is relevant when we talk about social networks as well. These criteria need to be measured and evaluated. Often, a large amount of social networking can be frustrating and does not give the desired result.

Figure 89: Picture Irma Morkuckienė

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Task for participants (Individual task):

Game "Bingo".

- In 3 minutes, participants shall meet as many participants as possible and learn about each other as much as possible while filling out a Bingo form.
- In 3 minutes, two participants shall learn about each other as much as possible by filling out the Bingo form at the same time.

Task No 1

Bingo game templet.

BINGO!

Find someone in the room who admits to these characteristics and ask her/him to write the name in the box. Learn about each person as much as possible. Complete all the boxes and talk to all people in the room and you will win BINGO! Do it as fast as possible.

The time to complete the task is 3 min.

Has a nickname.	Cannot cook.	Cannot use computer.	Cannot wake up early.
Cannot wear high heels.	Cannot play board games	Cannot wear jeans to work.	Cannot speak Russian.
Cannot swim.	Cannot knit	Cannot dance the waltz.	Cannot lose weight.
Can do sports.	Can cook.	Can use a computer.	Can wake up early.
Cannot tell a poem by mind.	Cannot draw.	Cannot drink coffee.	Cannot count by mind.
Can wear high heels.	Can play board games.	Cannot wear jeans to work.	Can speak Russian.
Can swim.	Can knit	Can dance the waltz.	Can lose weight.

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Can recite a poem from memory.	Can draw.	Loves coffee.	Can count in their head.

Figure 90: The tool for the game

If you have done all the tasks, BINGO!!!

Task No 2

Choose 1 person and discuss this topic. Learn about each person as much as possible.

The time to complete the task is 3 min.

Topics for discussion in couples:

- Do you have nickname?
- Can you wear high heels?
- Can you swim?
- Do you like sport?
- Can you recite a poem from memory?
- Can you cook?
- Do you like to play board games?
- Can you knit?
- Can you draw?
- Are you using PC a lot?
- Can you wear jeans to work?
- Can you dance the waltz?
- Do you like coffee?
- Can you wake up early?
- Can you speak Russian?
- Can you lose weight?
- Can you count?

Topics for discussion:

- Compare and comment on which game was achieved:
  - more comfort,
  - better and stronger interconnections was established,
  - more information was received,
  - the information was of better quality.
- How to assist PWD to find balance between quality and quantity in E-social networks?

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Summary: On a separate card (1.6) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

Figure 91: Photo Irma Morkuckienė

GENERAL SUMMARY OF TOPIC 1:

Participants attach their discoveries on the poster according to the topics (cards 1.1 to 1.6).

A map of new discoveries will be created.

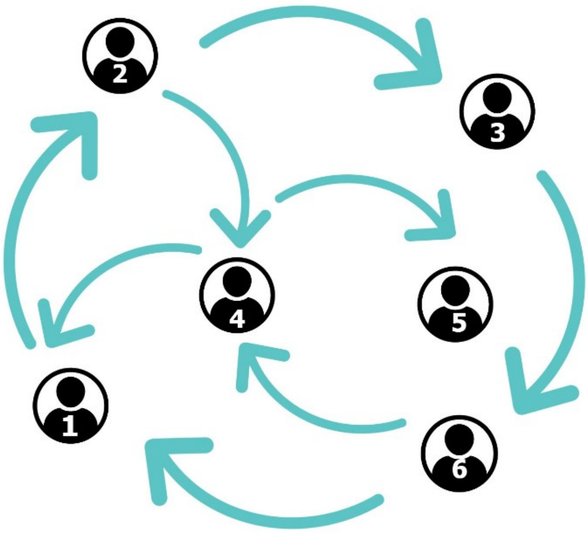

Figure 92: The map of new discoveries

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Topic 2: Practical Methods and Tools to Get Involved in E-Social Networks

One of the important factors is to make sure that there is a win / win situation between the social network participants. This type of relationship is important to the success of a social network.

Networking is not a one-sided game. You have to be a friend to find a friend.

Figure 93: Photo Eglė Gudžinskienė

2.1: Needs and Abilities of PWD

<u>Task for participants (Team task):</u>

Use a Design Thinking Method: "Design thinking is about getting to the root of a problem, rather than just treating some of the symptoms" (Prof. Hasso Plattner)[13].

With Design Thinking, professionals working with PWDs have the freedom to generate ground-breaking solutions. Using it, the team can get behind hard-to-access insights and apply a collection of hands-on methods to find innovative answers.

Go through the five steps of a Design Thinking process[14]:

- **Empathize:** Research your users' needs
  Here, you should gain an empathetic understanding of the problem you are trying to solve, typically through user research.

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- **Define:** State your users' needs and problems. Here you accumulate the information gathered during the Empathize stage. You then analyse your observations and synthesize them to define the core problems you and your team have identified.
- **Ideate:** Challenge assumptions and create ideas. You can start to “think outside the box”, look for alternative ways to view the problem and identify innovative solutions to the problem statement you have created. Brainstorming is particularly useful here.
- **Prototype:** Start to create solutions
  This is an experimental phase. The aim is to identify the best possible solution for each problem found.
- **Test:** Collect feedback from your target group. Analyse the results, make improvements, or decide if it is necessary to go back to an earlier step in the process.

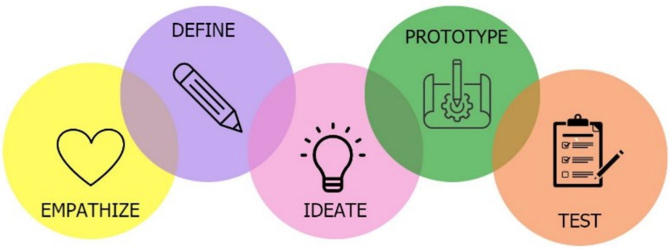

Figure 94: The five steps of a Design Thinking process

Topics for discussion:

- How to assist PWD to identify his/her needs and abilities to use E-social networks?

Summary: On a separate card (2.1.) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

2.2: Step by Step - Learning and Training

Task for participants (Individual task):

Find step-by-step formats from wiki How[15] that could help PWD understand how to use social networks.

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Topic	Video	Easy to read guide
How to get **Wi-Fi**	https://www.wikihow.com/Connect-WiFi-on-a-Cell-Phone	https://www.wikihow.com/Connect-WiFi-on-a-Cell-Phone
How to create a safe **password** and change it, remember it.	https://www.wikihow.com/Create-a-Password-You-Can-Remember https://www.youtube.com/watch?v=aEmF3Iylvr4	https://www.wikihow.com/Create-a-Password-You-Can-Remember
How to **download an app**.	https://www.youtube.com/watch?v=J_IALKPRJaE	https://www.wikihow.com/Download-Apps-on-Android
How to get from zero to **Zoom.**	https://www.youtube.com/watch?v=QOUwumKCW7M	https://www.wikihow.com/Download-Zoom
How to get from zero to **Skype**.	https://www.youtube.com/watch?v=lb31wbnoz_c	https://www.wikihow.com/Skype
How to get from zero to **Google Meet**.	https://www.youtube.com/watch?v=gm4s-D2-lyY	https://www.wikihow.com/Use-Google-Meet
How to get from zero to **GoToMeeting.**	https://www.youtube.com/watch?v=95dRdnMMgbQ	https://www.wikihow.com/Record-a-GoToMeeting-Session-on-Android
How to get from zero to **MS Teams**.	https://www.youtube.com/watch?v=dPYZ05EYai0&t=1s	https://www.wikihow.com/Create-a-Meeting-in-Teams
How to get from zero to **Messenger.**	https://www.youtube.com/watch?v=sufzQJPm0vk	https://www.wikihow.com/Install-Facebook-Messenger
How to get from zero to **WhatsApp.**	https://www.youtube.com/watch?v=3uXGT2I0iZ8	https://www.wikihow.com/Install-WhatsApp-on-Android
How to get from zero to **Viber.**	https://www.youtube.com/watch?v=3DqwkEusIzE	https://www.wikihow.com/Use-Viber
How to get from zero to **e-mail.**	https://www.youtube.com/watch?v=0WLWYJA7jjc	https://www.wikihow.com/Send-an-Email-Using-Gmail

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How to use google translator / **Voice-text translator.**	https://www.youtube.com/watch?v=TIG2ckcCh1Y	https://www.wikihow.com/Use-Google-Translate https://www.wikihow.com/Record-Google-Translate-Voice-on-Android
How to create and use **QR** codes.	https://www.youtube.com/watch?v=NtwCTo7T9zg	https://www.wikihow.com/Create-a-QR-Code https://www.wikihow.com/Scan-a-QR-Code

Figure 95: Step-by-step formats

Topics for discussion:

- How to help a multifunctional PWD understand the technical specifications for using e-mail or social networks?

Summary: On a separate card (2.2.) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

2.3: Tips and Tricks on How to Connect with Other People

Here are some easy-to-read instructions from wiki How[15]:

✓ How to build a social network?

https://www.wikihow.com/Build-a-Social-Network

✓ How to be friends with people from other social groups?

https://www.wikihow.com/Be-Friends-with-People-from-Other-Social-Groups

✓ How to shape your social network for happiness?

https://www.wikihow.com/Shape-Your-Social-Network-for-Happiness

✓ How to be social with people you don't know?

https://www.wikihow.com/Be-Social-with-People-You-Don%27t-Know

✓ How to cope with annoying people?

https://www.wikihow.com/Cope-With-Annoying-People

✓ How to be less annoyed with people?

https://www.wikihow.com/Be-Less-Annoyed-With-People

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- ✓ How to connect with people?

https://www.wikihow.com/Connect-With-People

- ✓ How to deal with people you don't like?

https://www.wikihow.com/Deal-with-People-You-Don%27t-Like

- ✓ How to deal with people talking about you behind your back?

https://www.wikihow.com/Deal-With-People-Talking-About-You-Behind-Your-Back

- ✓ How to deal with dumb people?

https://www.wikihow.com/Deal-With-Dumb-People

- ✓ How to deal with rude people?

https://www.wikihow.com/Deal-With-Rude-People

- ✓ How to deal with bossy people?

https://www.wikihow.com/Deal-with-Bossy-People

- ✓ How to deal with negative people?

https://www.wikihow.com/Deal-With-Negative-People

- ✓ How to deal with difficult people?

https://www.wikihow.com/Deal-With-Difficult-People

- ✓ How to deal with toxic people?

https://www.wikihow.com/Deal-With-Toxic-People

- ✓ How to deal with fake people?

https://www.wikihow.com/Deal-with-Fake-People

- ✓ How to deal with sensitive people?

https://www.wikihow.com/Deal-with-Sensitive-People

- ✓ How to deal with competitive people?

https://www.wikihow.com/Deal-With-Competitive-People

- ✓ How to deal with people who always complain?

https://www.wikihow.com/Deal-With-People-Who-Always-Complain

- ✓ How to deal with overly optimistic people?

https://www.wikihow.com/Deal-With-Overly-Optimistic-People

- ✓ How to interact with people?

https://www.wikihow.com/Interact-With-People

- ✓ How to deal with people who put you down?

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https://www.wikihow.com/Deal-With-People-Who-Put-You-Down

- ✓ How to be a people person?

https://www.wikihow.com/Be-a-People-Person

- ✓ How to treat people with respect?

https://www.wikihow.com/Treat-People-With-Respect

- ✓ How to set boundaries with people with borderline personality disorder?

https://www.wikihow.com/Set-Boundaries-with-People-with-Borderline-Personality-Disorder

- ✓ How to deal with people who strongly disagree with you?

https://www.wikihow.com/Deal-With-People-Who-Strongly-Disagree-With-You

- ✓ How to cope with Impatient people?

https://www.wikihow.com/Cope-With-Impatient-People

- ✓ How to stop labelling people?

https://www.wikihow.com/Stop-Labeling-People

- ✓ Social distancing and making music: How to sing together online?

https://www.wikihow.com/Sing-Together-Online

Practical exercise:

Prepare an E2R (Easy to Read) and an E2U (Easy to Understand) instruction for an individual user (based on a particular situation)[25].

Summary: On a separate card (2.3.) the participant writes what he/she has learned, re-learned, what discovery he/she has made for himself/herself.

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Figure 96: Photo Austėja Ašakėnė

2.4: Quality and Quantity of Information

Different authors distinguish different principles that are important in networking.

For example, Steven Snell16 identifies five basic principles that are important in networking:

1. Win / Win Situations where both parties benefit.
2. Give More Than You Get. Those who are genuinely helpful to others will be appreciated and will likely benefit greatly from their network.
3. Activity Beats Inactivity. In general, it is a good practice to be proactive in networking.
4. Quality Over Quantity. A small network with fewer, but stronger, connections will be much more effective than knowing hundreds of people but not having any depth to the relationships.
5. People connecting With People That They Like.

Our practice shows that these principles are important.

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Task for participants (Individual task):

Explain how you understand such principles (singled out by the authors of these courses) in networking:

- ✓ **Back and forth principle.**

That means you must be a good listener, not just a fun speaker. It is important to talk more than just about yourself when you need a network. Ask another person as well. And listen carefully to the answers. Ask them to answer the questions. It helps a person feel heard and appreciated.

- ✓ **The principle of positivity**.

Relationships are based on positivity. It may seem like a good idea to connect with others in terms of common problems. For example, you can try to contact a person by complaining about the weather. However, it is better to avoid negative language.

- ✓ **The principle of authenticity.**

It is important to be yourself. Talk about topics that sincerely interest you. This will interest others as well.

- ✓ **The principle of old connections.**

Networking is not just about meeting new people. It is also about keeping in touch. Think more than just getting to know new people. Remember to stay in touch with the circles of people you already have.

- ✓ **The principle of mutual assistance.**

It is important not to be afraid to turn to your network when you need advice or help.

Practical exercise:

Create a visually clear map for your service users about the quality and quantity of information.

Summary: On a separate card (2.4.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

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Figure 97: Photo Irma Morkuckienė

2.5: Data Reliability

<u>Task for participants (Individual task):</u>

The internet can be a wonderful resource for social networking. The internet is accessible, both for those who want to initiate social networks and for those who want to participate. Since there is so much readily accessible information, internet users must learn to filter the data they find on the World Wide Web, because the providers of information may misuse the information in order to appear convincing. Therefore, Internet users should learn to evaluate data carefully, critically, and even sceptically. This is a big challenge for PWD.

It is important to train PWD on how to check if a site is secure.

To help protect your personal information, we need to check seven things to determine if a site is secure. Here you can find very specific, easy-to-read and easy-to-understand infographics that summarize safety features https://www.pandasecurity.com/en/mediacentre/security/what-makes-websites-trustworthy/

PWD needs to be made aware of reliable and unreliable sources of social networks.

The various social networking sites that anyone can write and publish online cannot be considered completely trustworthy. Websites and blogs with news based on personal opinion cannot be considered completely reliable.

The PWD must be trained to recognize fake news, how to spot fake ads, and avoid getting scammed while shopping online. Easy-to-understand tips can be found here. https://www.globalsign.com/en/blog/tips-for-avoiding-online-shopping-scams-what-to-do-if-you-are-a-victim-of-one

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Summary: On a separate card (2.5.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

2.6: The Importance of Accessibility and Usability

Social media can really help with meeting other disabled people. There are no geographic boundaries on the internet. There are often specific groups or communities dedicated to disability or a specific disability or category of disabilities. In fact, there are groups that are more specific. For example, there are groups about the accessibility of a specific product for people with a specific disability or a specific area of life such as employment or independent living, for people with a specific disability.

The internet has allowed disabled people to create and share their own art, writing, music, and other creations with the world. This has meant that disabled people have been able to publish work that traditional publishers or distributors may consider not to be commercially viable and show that it is very commercially viable.

There is a lack of employers willing to be inclusive. Self-employment is sometimes the best or only way for some disabled people to access certain careers. Social media may be the only way they can access to engage people with their business if in-person sales. E-marketing may be quicker, more efficient, and more cost-effective.

Summary: on a separate card (2.6.) the participant writes what he / she has learned, re - learned, what discovery s/he made for himself/herself.

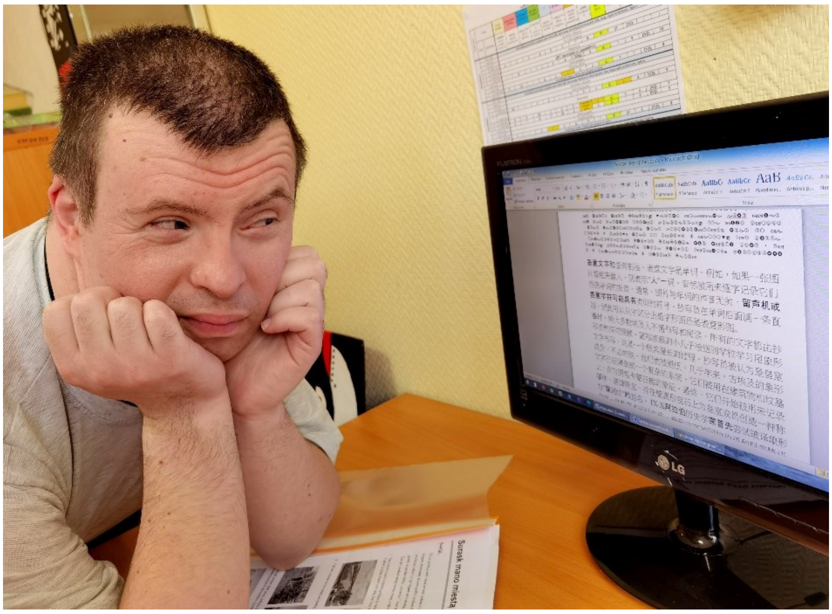

Figure 98: Photo Irma Morkuckienė

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GENERAL SUMMARY OF TOPIC 2:

Participants attach their discoveries on the poster according to the topics (cards 2.1 to 2.6).

A map of new discoveries will be created.

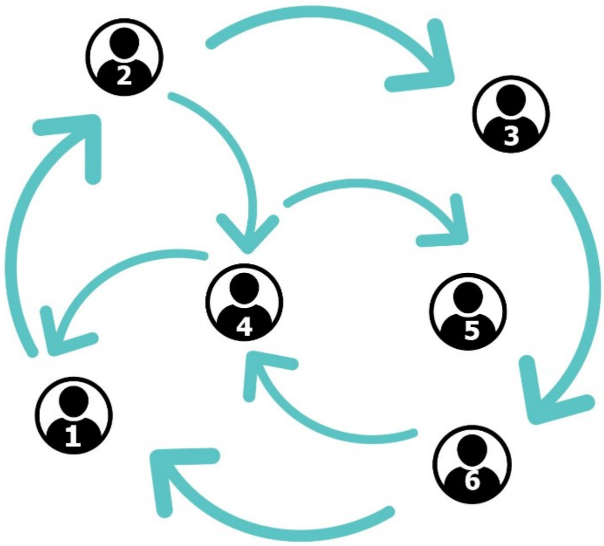

Figure 99: The map of new discoveries

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Topic 3: Safety and Ethics on E-Social Networks

3.1: Data Protection and Attitudes

The people's attitudes towards disability. The techniques and methods to build inclusive, understanding communities.

Examples of practice:

Here is an example of good practice for Jaunuolių Dienos Centras, Panevezys, Lithuania.

https://www.youtube.com/watch?v=IUugZi47CuU

Here are some easy-to-read and easy to understand texts from Wiki How:

- ✓ How to Interact with People Who Have Disabilities?
https://www.wikihow.com/Interact-With-People-Who-Have-Disabilities
- ✓ How to Act Around People With Special Needs?
https://www.wikihow.com/Act-Around-People-With-Special-Needs
- ✓ How to Deal with People Who Treat You Like a Child?
https://www.wikihow.com/Deal-With-People-Who-Treat-You-Like-a-Child

Summary: on a separate card (3.1.) the participant writes what s/he has learned, re-learned, what discovery s/he made for himself/herself.

3.2: Rights to Privacy

Task for participants (Individual task):

Read the Charter of Fundamental Rights of the European Union (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012P/TXT&from=EN) and find out what it covers and how it relates to the European Convention on Human Rights (2012/C 326/02) https://www.echr.coe.int/documents/convention_eng.pdf. Select the most important articles of the Charter of Fundamental Rights related to social networks, privacy, and human rights. Justify why these articles are relevant for PWD. Discuss with the group.

Topics for discussion:

- Examine the document and highlight the most important points related to the social network.

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Summary: On a separate card (3.2.) the participant writes what s/he has learned, re-learned, what discovery s/he made for himself/herself.

3.3: Top E-Network Security Mistakes

Cybersecurity mistakes made by individuals are the most common cause of cyber security breaches.

After researching many sources, we have compiled a list of cyber security rules that everyone should know to stay safe and avoid data breaches.

Weak passwords are one of the most common cyber security mistakes that lead to data breaches.

It is important to adhere to secure cyber security rules and make it harder for cyber attackers to access devices, accounts, or personal information.

Kaspersky a global cybersecurity company describing the top 10 mistakes users make and how to avoid them to keep the social network safe https://www.kaspersky.com/resource-centre/threats/top-10-computer-security-mistakes

Based on the literature and practice, we have compiled a list of rules to follow to avoid cyber security errors:

- **Be secure with email**. Do not open email if you think this is suspicious. Do not open junk e-mail Postal links or attachments. Check Sender Don't reply to unsolicited email. Never share personal information, credit card numbers or account passwords, emails.
- **Create strong passwords.** Get creative - add characters to words or use random words. Do not use common words, character combinations, or easily accessible personal information in passwords. Do not reuse passwords - create a new password for each online account.
- **Be especially careful in public places**. Public Wi-Fi is free and a great way to keep up with social networks, but it is also not secure.
- **When you see a computer software update, do it!** Software updates fix security vulnerabilities in the applications and applications that you use on your devices.
- **Do not use untrusted sites**. Another easily avoidable disadvantage of cyber security is browsing insecure websites.
- **Do not connect unknown USB sticks to your computer**. If in doubt, use a new USB stick. Keep USB drives in a safe place.
- It is important to know that everyone is at risk of a cyber-attack. The only question is when someone will suffer from certain cybercrime.
- Cyber security is the duty of every human being.

Safety in E-communication:

Based on the literature and practice, we have identified key aspects of security in E-communication:

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- Social networks facilitate communication and interaction online. When people communicate and interact online, their private lives often become public. Social networks such as Facebook, Instagram and Twitter have sparked new trends in the way people exchange and communicate information, particularly personal images. These platforms actively encourage people to share their lives with their friends, family, and social connections within the digital environment.
- All too frequently, people's images are captured in photographs and shared on social networks without the person knowing that their images have been taken and shared online.
- We should talk about the right to be forgotten.

The need to control the flow of personal information to different types of relationship is central to the social world. For example, we may share different information with an intimate partner but not with a parent or employer. Being able to distinguish between these things is important both in the face to the face communication process and in the online communication process. This needs to be learned by individuals with intellectual disabilities.

There are the examples of the best Practices: Safe Social Networking made by University of Pittsburgh.

https://www.technology.pitt.edu/security/best-practices-safe-social-networking

Topics for discussion:

There are various privacy threats related to the disclosure of personal information to other users:

- Intentional traps (snooping, hacking) that can have serious consequences.
- Accidental traps (mismanagement of privacy settings by the user, lingering data) that also can have serious consequences.
- Good and bad behaviour examples on the internet.
- Fake news and online disinformation. How it could affect social networking.

Summary: On a separate card (3.3.) the participant writes what s/he has learned, re-learned, what discovery s/he made for himself/herself.

3.4: Morality and Ethics on the Internet

What is Morality? Morality refers to the set of standards that enable people to live cooperatively in groups. It is what societies determine to be "right" and "acceptable".

Individuals who go against these standards may be considered as immoral[18].

Morals and Laws. Both laws and morals are meant to regulate behaviour in a community (in an e-community as well) to allow people to live in harmony. Both have firm foundations in the concept that everyone should have autonomy and show respect to the other.

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Ethics. Ethics is based on well-founded standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues. Ethics refers to well-founded standards of right and wrong that prescribe what humans ought to do[19].

Making and keeping agreements are a major part of ethics. The principle of benevolence — to give aid to others in need is important as well.

Ethical principles appear on three levels: the individual, social, and global level. Social principles apply within a society, a group whose members share cooperative benefits and burdens with each other. Global or transnational principles apply to concerns that cannot be handled by dividing them between societies. Ethical issues on the internet involve principles at all three levels.

One of the most actual ethical questions on internet ethics revolves around privacy online[20].

Communicating ethically involves being egalitarian, respectful, and trustworthy—overall, practicing the "golden rule" of treating your audience the way you would want to be treated.

Issues of copyright and privacy are also individual ethical issues with significant social-ethical dimensions.

Summary: On a separate card (3.4.) the participant writes what s/he has learned, re-learned, what discovery s/he made for himself/herself.

3.5: Responsibilities on E-communication

Based on the literature analysis and experience with PWD, the following main responsibilities can be identified in the field of E- communication:

- ✓ be concise. Concise means brief and to the point.
- ✓ be clear. If your message is unclear, the audience will lose interest and tune you out, bringing an end to effective communication.
- ✓ be punctual. Do not talk to long.
- ✓ be ethical. Ethics refers to a set of principles or rules for correct conduct.
- ✓ be egalitarian. To communicate in an egalitarian manner, speak and write in a way that is comprehensible and relevant to all your listeners or readers, not just those who are "like you" in terms of age, gender, race or ethnicity, or other characteristics. Do not dominate the conversation.
- ✓ be respectful. People are hurt by sarcasm, insults, and other disrespectful forms of communication.
- ✓ be trustworthy. Trust is a key component in communication. Many wise people have observed that trust is hard to build but easy to lose. Communicate what you know, and if you do not know something, research it before you speak or write.

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Topics for discussion:

Recall one time you felt offended or insulted in a conversation. What contributed to your perception? Please share your comments.

Summary: On a separate card (3.5.) the participant writes what s/he has learned, re-learned, what discovery s/he made for himself/herself.

3.6: Main Legislation

Task for participants (Individual task):

Review the legislation and map out ideas why it is important for a professional to know the legislation to ensure the well-being of PWD.

- ✓ Strategy for the Rights of Persons with Disabilities 2021-2030. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12603-Disability-rights-strategy-for-2021-30
- ✓ European Disability Strategy 2010-2020. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM%3A2010%3A0636%3AFIN%3Aen%3APDF
- ✓ United Nations Convention on the Rights of Persons with Disabilities. https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf
- ✓ United Nations 2030 Agenda for Sustainable Development. https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
- ✓ European Accessibility Act. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0882

Topics for discussion:

- How legislation can affect social networks in which PWD is involved.

Summary: On a separate card (3.6.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

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Figure 100: Photo Irma Morkuckienė

3.7: Roles of the Supporter

<u>Task for participants (Individual task):</u>

Use the method: **"Crazy 8s "!**

Try using the "crazy 8s" technique to help individuals generate ideas. It is a sketching activity composed of three rounds.

Round 1: 8 ideas in 5 minutes. Each participant folds a sheet of paper in half 3 times, then unfolds the paper.

Each individual sketch 8 ideas in 5 minutes, one in each of the 8 rectangles created.

Round 2: 1 big idea in 5 minutes. Each person works individually to sketch one big idea in 5 minutes on a new piece of paper. You can build on a previous idea or combine elements of several ideas from the previous round.

Round 3: 1 storyboard/wire flow in 5 minutes. Building on the "big idea" from round 2, everyone uses a new piece of paper to sketch a storyboard on all the key steps related to that idea that a user needs to take.

<u>Topics for discussion:</u>

- Optimal roles of a supporter.
- How to avoid hyper help.

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Identification of obstacles for PWD by E-social networking

The following obstacles can be identified:

- Verbal communication
- No easy to read(E2R) and easy to understand (E2U) language for people with intellectual disabilities.
- Self-confidence.

Summary: On a separate card (3.7.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

Figure 101: Photo Austėja Ašakėnė

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GENERAL SUMMARY OF TOPIC 3:

Participants attach their discoveries on the poster according to topics (cards 3.1 to 3.7).

A map of new discoveries will be created.

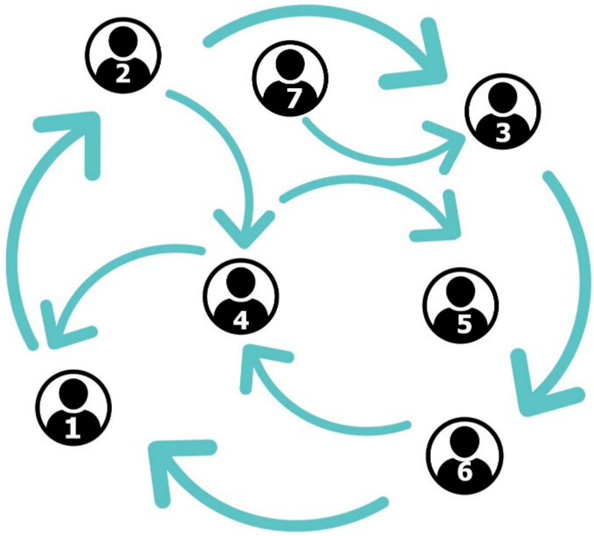

Figure 102: The map of new discoveries

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Topic 4: Technological Aids that Could Assist in Conventional Social Networks

Common European accessibility standards help remove barriers for people with disabilities and others (e.g., the elderly). When applied across Member States, these standards also improve the functioning of the internal market, by removing barriers to free movement of goods and services[22].

Key EU legislative instruments (the directive on web accessibility, the European accessibility act, the public procurement directives) refer to the possible use of accessibility standards.

Task for participants (Team task):

Discussion on ICT accessibility resulting in European Standard EN 301 549 (Accessibility requirements suitable for public procurement of ICT products and services in Europe). https://www.etsi.org/deliver/etsi_en/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf

Discussion on statements intended to describe the functional performance of ICT enabling people to locate, identify, and operate ICT functions, and to access the information provided, regardless of physical, cognitive, or sensory abilities.

Subtopics for discussion:

4.2 Functional performance statements.

4.2.1 Usage without vision.

4.2.2 Usage with limited vision.

4.2.3 Usage without perception of colour.

4.2.4 Usage without hearing.

4.2.5 Usage with limited hearing.

4.2.7 Usage with limited manipulation or strength.

4.2.8 Usage with limited reach

4.2.9 Minimize photosensitive seizure triggers.

4.2.10 Usage with limited cognition.

4.2.11 Privacy.

There are apps and assistive technologies that help people with special needs to make friends and establish social networks. Making and keeping conversations is something that is difficult for some people, and it is hard for them to initiate the conversation.

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There is an array of disabilities and the point of some apps is to find people with the same needs so they can feel less alone, less isolated, and less depressed.

There are some easy to read and easy to understand materials. But most of this material is in English and it is often too complicated with a lot of additional information around. For many PWD, it is impossible to download and to use existing social communication apps without help.

For people who cannot read and cannot follow the visual instructions, as for people with attention disorders it is too many steps. For PWD it should be just 1-2 buttons to press and to get into the conversation.

Figure 103: Photo Irma Morkuckienė

4.1: Assistive Technologies for People with Visual Impairment

Here are some examples of Assistive Technology for Blind or Low Vision[24]:

Screen-reading Software

- Uses synthetic speech to read aloud the content that appears on a computer screen.
- Compatible with most programmes and features for PC operating systems.
- Available as an add-on for PCs running Linux or Windows, while Mac computers typically run a built-in screen-reading function.
- Examples of screen-reading software include JAWS and WindowEyes for PC, VoiceOver for Mac and Orca for certain distributions of Linux.

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Magnification Software

- Works similarly to a high-powered magnifying glass moving over a page. They can magnify all screen items by following the mouse cursor or keyboard.
- Compatible with most Windows operating systems. Mac computers have a built-in magnification function.
- It is possible to use screen magnification software in conjunction with a screen reader for individuals who need both types of technology.
- Examples of screen-magnification programmes include ZoomText and Magic.
- Some low-vision individuals might be able to benefit from larger monitors and internal features that enlarge font, increase contrast or otherwise modify computer functions.
- However, those features are not adequate for many low-vision Individuals and additional magnification software is necessary.

Dictation Software

- These programmes often utilize standard QWERTY keyboards, but other modified accessories can be used as well.
- Individuals who are blind or have low vision usually learn to touch-type, but if a blind individual has an additional disability that affects typing proficiency, the individual may be interested in trying dictation software.
- It will be important to research the compatibility of any dictation software with the screen reader of choice prior to making a purchase.
- Writing Braille and Using Braille Embossers https://www.youtube.com/watch?v=KYZ1LUVBPAI&t=76s
- Writing braille by hand with a slate and stylus is portable and most appropriate for shorter notes.
- Individuals can also type braille manually with Perkins's braillewriters although they are not as portable.
- Software can convert electronic text into a braille hard copy by sending computer files to a braille embosser, which is the braille equivalent to an ink printer.
- Braille embossers typically require heavyweight paper and utilize more pages than print.
- Embossing contracted braille requires the use of a braille translation software programmes.

Refreshable Braille Displays

- Operates by raising and lowering combinations of pins to create braille characters.
- Allows individuals to both read and write braille quietly and save files.
- Portable and usually able to interface with a computer and/or connect to the internet.

Optical Character Recognition (OCR) Systems

- Involves scanning a printed document into a computer and converting the picture image into text characters and words, which screen readers and braille embossers can recognize.
- If a pre-scanned electronic image is already available (e.g., if you have a PDF file), OCR systems can convert it into text without scanning a hard copy.

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- This content can be read using synthesized speech, screen enlargers, and braille embossers.
- When choosing an OCR system, be sure it does the following:
    - Recognizes a wide variety of typed/printed documents.
    - Retains the layout of the original text.
    - Copes well with columns, various paper sizes, and horizontally formatted documents.
    - Supports different types of scanners.
    - Comes with ongoing technical support and documentation in an accessible format.
    - Features an accessible interface.

Portable Magnifiers

- There are also video magnifiers with handheld cameras, which are portable and useful for practical things like reading signs and labels on the go.
- Head-mounted displays (HMD) also offer portability and new ways of viewing the magnified images.
- Portable notetakers are small information management devices. They have braille or QWERTY keyboards for input and a synthesized voice and/or braille display for output.
- Braille notetakers and other devices with refreshable braille displays can also be used to read materials.
- Portable book readers allow individuals to access specially coded files via speech.
- Accessible GPS devices or smart phone apps can provide turn-by-turn voice instructions
- There are many apps for smart-phones and tablets that serve similar purposes to the hardware and software listed including GPS, OCR and audiobook players.
- These range in price and might require a subscription or application approval.

Here are some examples of Assistive Technology for People with Visual Impairment:

- **VizWiz** lets blind users recruit remote sighted workers to help them with visual problems in nearly real-time. Users take a picture with their phone, then speak.
- **Doro PhoneEasy® 331** Big buttons on a clear and spacious keypad make dialling easier than ever, while photo memories connect you with special people at the simple press of a button. https://www.doro.com/en-gb/

Summary: On a separate card (4.1.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

4.2: Assistive Technologies for People with Hearing Impairment

Here are some examples of Assistive Technology for People with Hearing Impairment:

- ✓ **Ava App** — for iOS & Android https://www.ava.me/

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✓ TAPTAP The TapTap app allows those with hearing loss to react to sounds. When it detects noise, the app will vibrate and flash to alert the user.

Summary: On a separate card (4.2.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

4.3: Assistive technologies for People with Motor Impairment

Computer access for people with mobility disabilities may be achieved through:

- keyboard adaptations.
- alternative keyboards.
- an expanded keyboard.
- a mini keyboard.
- mouse alternatives.
- assistive technology software.

Examples of assistive technologies[23]:

- **Head wands** and **mouth sticks** are devices that fit over the head or into the mouth and extend toward a control interface.
- A **single switch** is a device - often a large button or touch-sensitive pad - that is placed near a body part to be clicked.
- A **sip-and-puff switch** has the same functionality as a single switch but is operated by blowing and sucking air into a mouthpiece.
- An oversized trackball mouse is a trackball whose larger dimensions make it easier to operate with assistive devices such as a head wand.
- An **adaptive keyboard** may feature word-completion technology as well as raised gaps between keys that allow users to rest their hands in place when not typing and during muscle spasms.
- People with limited or no hand control sometimes prefer eye-tracking devices, which register the user’s eye movements and use them to navigate the web.
- While it can be costly, voice recognition software offers some users the option to navigate the web via direct voice commands smoothly. But others with motor disabilities find that their throat muscles are also affected - for example, by cerebral palsy - to such an extent that typical voice recognition software cannot consistently interpret their speech. https://www.telerik.com/blogs/motor-disabilities-and-what-you-need-for-accessibility

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- Mouth stick - a device that allows users to control input (whether that be moving their wheelchair or surfing the web) with a stick they manipulate with their mouth.
- Head wand - a device similar to a mouth stick, but users control input with their head instead of their mouth
- **Speech Recognition Software:** Speech recognition software helps users create text and navigate online by speaking into a microphone. This may be useful for users who have problems with fine motor skills or limited mobility. One example of speech recognition software is Dragon NaturallySpeaking. This speech recognition software can assist those who have limited mobility and trouble controlling their movements. Dragon NaturallySpeaking allows users to email, navigate the internet, dictate homework, and more.
- **Speech generating device**: A speech generating device is "a portable that contains one or more panels or switches that when depressed will activate pre-recorded digitized or synthesized speech output." These may be a standalone device, usually very small and light, or it can be software that is installed in a tablet or phone. People with a physical disability may not be able to speak on their own and can use a speech generating device to communicate with the people around them.
- **GoTalks** are a type of speech generating devices. GoTalks are offered with various amounts of communication options and sizes.
  https://guides.library.illinois.edu/c.php?g=533633&p=3651132

Summary: On a separate card (4.3.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

4.4: Assistive Technologies for People with Cognitive Impairment

Here are some examples of Assistive Technology for People with Cognitive Impairment:

- ✓ **MAF** (Making Authentic Friendships). The web-based application helps individuals with special needs to find friends. For iOS and Android.
  http://www.makingauthenticfriendships.com/

Summary: On a separate card (4.3.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

4.5: Assistive Technologies for People with Speech and Language Impairment

For some people, verbal communication can be extremely difficult. In response, experts developed special software for Augmentative and Alternative Communication (AAC). These apps allow people

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to communicate by touching the screen. In effect, the app gives words to those who cannot speak. AAC technology has proven to be especially useful for people with autism and intensive use of AAC apps has been known to dramatically improve the speech abilities of autistic people.

These are some examples of symbol-based communication:

- ✓ **CoughDrop.** https://www.mycoughdrop.com/; https://www.youtube.com/watch?v=ELNKXfvTDbA
- ✓ **TalkTablet,** helps a person to communicate effectively. https://talktablet.com/
- ✓ SpeechWatch - Wearable AAC Speech Device - Stand alone https://www.youtube.com/watch?v=2ezFoRvxuyc
- ✓ **Magnetic clip-on** Bluetooth speaker https://gusinc.com/product/xmagnetic-clip-on-bluetooth-speaker-black-offers-good-volume/
- ✓ **Samsung Wemogee** provides ideograms to assist persons who live with aphasia, an impairment of language that takes a toll on the ability to speak aloud, write, and read. https://www.youtube.com/watch?v=oLPUe6rA5IU&feature=emb_logo; https://news.samsung.com/global/samsung-wemogee-a-new-communication-tool-for-people-with-language-disorders
- ✓ **Verbally talks** for you. www.verballyapp.com/about_us; https://www.youtube.com/watch?v=EaNGLSvBQ9U
- ✓ **Speak It!** Text-to-Speech https://www.youtube.com/watch?v=oqODEciGHqw
- ✓ SmallTalk is designed for people with aphasia, an impairment in the ability to use language. https://www.aphasia.com/ , https://www.youtube.com/watch?v=PhRetGBIJPA
- ✓ **Grid Player** is an app that helps people who cannot speak, or who have unclear speech, to communicate. Sentences that you create are spoken out loud. https://thinksmartbox.com/, https://www.youtube.com/watch?v=xduvmdz3N3M
- ✓ **ChatAble** Create and use symbol-based grids, or use photos to make visual scene displays. https://therapy-box.co.uk/, https://www.youtube.com/watch?v=0lmeh4Vx3OQ
- ✓ **Predictable** is an augmentative and alternative communication (AAC) app designed to give a voice to someone who cannot use their own natural voice. https://therapy-box.co.uk/ https://www.youtube.com/watch?v=iO96rc4zozc

AR (Augmented Reality) is used for enabling Sign language to be seen by other AR users and understood via a real-time translation. The concept allows a person using sign to communicate to a person that does not understand sign language. The visual movements of the sign language user are interpreted and translated to the AR user either visually or via audio (Deb, Suraksha & Bhattacharya, 2018). This use of AR means that people using sign language are able to communicate in their first language with a wider audience.

Summary: On a separate card (4.5.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

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4.6: Assistive Technologies for Safety Protection

Assistive Technology That Can Support Safety on communication.

There are assistive technologies that can support the safety of PWD. For example, some doorbells and fire alarms can either flashlight for people who are Deaf or make sounds and disable the lights for people with epilepsy, special plugs etc.

But there is truly little assistive technology that can support safety in communication.

There are secret buttons associated with the police if a person experiences violence.

Summary: On a separate card (4.6.) the participant writes what he/she has learned, re-learned, what discovery he/she made for himself/herself.

GENERAL SUMMARY OF TOPIC 4:

Participants attach their discoveries on the poster according to topics (cards 4.1 to 4.5).

A map of new discoveries will be created.

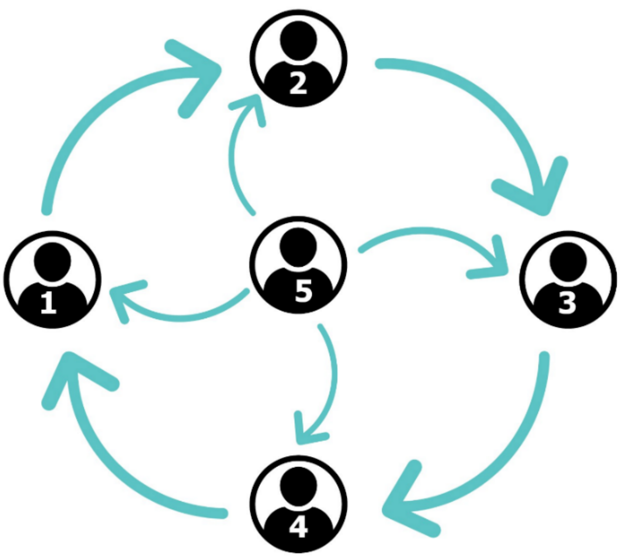

Figure 104: The map of new discoveries

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Summary:

The ability to network competently in a wide range of situations is a truly valuable asset.

A fundamental goal of networking is to meet new people and connect with people we would like to know better.

Key concepts of the Unit:

Increased employee (supporter) ability and competencies to assist PWD in the following areas:

- **understand how social networks work.**
- **know the basic methods, tools, and rules for getting involved in social networks.**
- **know the basic methods, tools, and rules for initiating social contacts (networks).**
- **know ethical and safety standards in social networks.**
- **know assistive technology to compensate for disability.**

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Learning Evaluation:

A. Self-Assessment Questions:

Question 1 – The common roles in e-social networks are:

a. Passive, Active, Neutral/Observer, Leader/Initiator, Participant
b. Positive, Negative, Participant, Good Person, Active
c. Neutral, Passive, Negative, Positive, Initiator of Conflicts
d. Leader, Organiser, Planner, Participant, Commentator
e. None of the above

Question 2 – The types of e-social networks are:

a. Friends E-network and Hobby E-network
b. Interests and Learning E-network
c. Entrepreneurship and Professional E-network
d. E-health Network and Self-help Groups
e. All the above

Question 3 – What are the correct five steps in the design thinking process?

a. Empathize, Define, Invent, Evaluate, Test
b. Empathize, Define, Ideate, Prototype, Test
c. Summarise, Define, Ideate, Prototype, Test
d. Empathize, Define, Ideate, Innovate, Test
e. None of the above

Question 4 – What are the main e-networking security mistakes?

a. Improper password use; good education; updating
b. Improper password use; lack of education; open-mindedness
c. Improper password use; lack of education; updating
d. None of the above
e. All the above

Question 5 – Which person needs special technological aid?

a. A person with visual and hearing impairment
b. A person with motor impairment
c. A person with cognitive impairment

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d. A person with dyslexia
e. All the above

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B. Activities:

Activity 1 – Discussion No 1

Discussion 1:

- How to assist PWD to understand the benefits of E-social networks?

Subtopics for discussion:

- Is in-person verbal communication better compared to other forms of communication, such as written communication, signing, and online communication?

Activity 2 – Discussion No 2

Discussion 2:

- How to assist PWD to find relevant E-social networks?

Subtopics for discussion:

- How do we label social networks?
- Are the people that PWD meet on social networks their real friends?
- Do social media contribute to real socialisation for PWD?
- Are there things that we can do to minimise the risk of problems?

Activity 3 – Practical Exercise

Practical Exercise:

- Create a visually clear map for your service users on the quality and quantity of information.

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UNIT 4: Therapeutic Role-Playing

Aim:

People take many roles in their everyday lives. Communication and social interaction are complex conditions, under which social and life skills are required that PWD either do not have or have the knowledge about, which is very difficult for them to use properly.

Therapeutic Role-Playing has beneficial effects of educating and also enhancing such skills. Technological advances and new assistive technologies can perform a major role in this direction. Augmented and Virtual Reality apps and kits illustrate the new era of education in this field.

In this Unit, professionals working with Persons With Disabilities (PWD) will learn how to educate PWD to use Augmented and Virtual Reality.

Learning Outcomes:

After completing the course, the learner will be in a position to:

In terms of **knowledge:**

- ✓ Define what role- playing is.
- ✓ Demonstrate the benefits of role- playing.
- ✓ Illustrate the guidelines in developing role- playing exercises.
- ✓ List examples of role- playing exercises.
- ✓ Name the techniques of role- playing.
- ✓ Illustrate the connection between role- playing and digital technology.
- ✓ Show the multi-media (applications, computer etc.).
- ✓ Why technological devices are important for PWD?
- ✓ What kind of abilities is reinforced in association with technology?
- ✓ Classify the Knowledge in regard of new assistive technologies.
- ✓ What is Virtual and what Augmented Reality?
- ✓ Explain what “social skills” means and how important is for PWD.
- ✓ Demonstrate the “Current training methods” for social interaction skills.
- ✓ Illustrate the “Benefits of Virtual and Augmented Reality combined with physical manipulatives”.

In terms of **skills:**

- ✓ Build effective scenarios, case studies, and role plays.
- ✓ Identify what skills can be developed by using role- playing.
- ✓ Discover in which areas of social skills the PWD needs help.

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- ✓ Select the best techniques of Therapeutic Role-playing (TRP) in order to educate the PWD.
- ✓ Organize the apps and toolkits of virtual and augmented reality that could be helpful for PWD.
- ✓ Examine the pros and cons of using virtual and augmented reality.

In terms of **attitudes:**

- ✓ Assess the benefits of TRP.
- ✓ Justify the effectiveness of TRP.
- ✓ Combine activities in order to better educate a PWD.
- ✓ Deduct factors of real-life activities that could frustrate the PWD.
- ✓ Test which app or toolkit is appropriate for a number of difficulties.
- ✓ Combine different social skills in order to achieve the best result for PWD.
- ✓ Estimate the wishes, the abilities and the needs of people with disabilities.

Topics:

- Therapeutic Role-Playing
- Social Skills, Life Skills and the Importance of Self-Regulation
- Virtual Reality and Augmented Reality. Ethical Challenges

Key Words:

• Therapeutic role-playing • Social skills • Self-Regulation • Life skills • Social stories • Video modelling • Assistive technology	• Intellectual disabilities • Autistic Spectrum Disorder • Augmented Reality • Virtual Reality • Ethical challenges

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Topic 1: Therapeutic Role-Playing (TRP)

1.1: Introduction

The main objective of the training unit is to provide the essential knowledge, skills and attitudes on therapeutic role-playing connected with assistive technologies and the related knowledge about socio-technical arrangements for healthcare professionals. Target is to enable healthcare professionals to address the needs of people with intellectual, mental or neuro-developmental disabilities and contribute to their empowerment for an independent and dignified life with respect to Assistive Technology (AT).

The Unit addresses the latest studies as concerns the field of social skills, skills of life and skills of self- regulation and their importance for persons with mental, intellectual or neurodevelopmental disabilities. Another objective of this unit is to increase the awareness that Assistive Technologies are part of a complex socio-technical system which has to be understood in order to utilize and maximize benefits and potentials. Therefore, participants also learn about ethical issues, acceptance factors as well as issues of data protection and usability.

1.2: Definition of Role-Playing

Role-playing is an alternative learning technique which is used to facilitate teaching in a plethora of cognitive and social settings. The role-playing approach can be used in a variety of settings. The main principle behind role-playing is that the trainee assumes a particular personality of a different person, such as a Historical character.

According to Jones (1982), persons "must accept the duties and responsibilities of their roles and functions, and do the best they can in the situation in which they find themselves". Role-playing can be defined as a range of techniques which deliberately create a simulation of real life in controlled conditions.

It is widely used by counsellors regardless their theoretical orientation in order to assist their clients to deeper understand themselves and achieve the change within (James & Gilliland, 2003). Role play constitutes a safe environment in which a decided behaviour can be performed by the client. According to Cormier and Hackney (2012, p. 211) as a technique it mixes "Salter's conditioned reflex therapy, Moreno's psychodrama technique, and Kelly's fixed-role therapy".

Moreno's psychodrama process/therapeutic model is considered of great importance and is also widely used in health and mental health settings (Kipper, 1997. Kirk & Dutton, 2006). It originates from theater, psychology and sociology and constitutes also a format of psychotherapy. As a session it includes three contexts the social, group and the dramatic and includes three distinct phases the warm-up, the action and the sharing. Its key five instruments are the protagonist, the stage, the auxiliary-ego, the director and the audience (Rojas-Bermúdez, 1997. Moreno, 1993. Moreno & Moreno, 2012. Cruz, Sales, Alves & Moita, 2018).

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In addition, there is a big variety of researchers who put role-playing among the most important and effective Therapeutic techniques in mental health (therapeutic role-playing).

Role-playing is a highly developed technique with multiple formats and purposes in psychotherapy. It is also a technique that helps most of the therapists or adult educators feel comfortable as they might have used it during their training or in their work with patients.

Modern learning theories identify three fundamental elements that effect the learning process:

- active participation;
- collaborative practices; and
- purposeful activities (Vosniadou 2000, Walberg & Paik 2000).

Role-playing embodies all three elements and is particularly useful for the development of cognitive and social skills.

Educators can use this technique to ensure active participation during the learning process. During role-playing, students enter a "theatrical" setting that enables them to "play" and "experience" real-life everyday situations within a safe learning environment that gives room for trial, error-making and practice.

During role-playing, the person assumes roles that refer to certain professional or social-scale situations in order to learn more about them and improve their responses. According to this technique, a group of students, which may also include the educator, re-enact certain scenarios or events with the purpose of teaching. Role-playing pairs active participation with group work and experiential learning, in order to deliver a learning activity that imitates real-life situations. Participants are encouraged to engage, physically and mentally, with the learning process, to express their views within a safeguarded scientific setting and build their knowledge around difficult, abstract and complex concepts.

Role-playing is one of the most commonly used techniques in adult training programmes. Its specific character fits within the social family of models makes role-playing a teaching strategy that emphasizes in the social nature of learning and sees cooperative behaviour in stimulating students both socially and intellectually.

More specifically, we can say that role-playing can be used when we want to analyse problematic and confrontational situations which refer to skills, behaviours and communication.

Through post-play feedback provided to "actors" by students themselves and the educator, role-playing delivers learning advantages that aim to improve and trigger the skills and attitudes that are examined through the learning programme.

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Figure 105: Role-playing Therapy Scenario (Sober College)

Role-playing is the by-product of three learning components:

- playing.
- play games.
- simulation.

In education, simulation is often referred to as played simulation, a more disciplined activity compared to plain games. Simulation utilizes detailed structures that represent real-life situations (Adams 1973). In role-playing, all key components are based on the concept of playing. It is "playing" that makes the technique so successful in terms of concept development and learning. Playing is a means for building knowledge and reason (Piaget 1951). Persons are already experienced in playing, since the urge to play (and the latter's learning capabilities) is a key human feature deeply rooted inside every child's psychology (Taylor 1987). In this technique, playing fulfils an educational function since its structure and execution are both assigned to an educator while the people are carrying out the play in order to achieve specific learning results (McSarry & Jones 2000).

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1.3: Key Features of Role-Playing

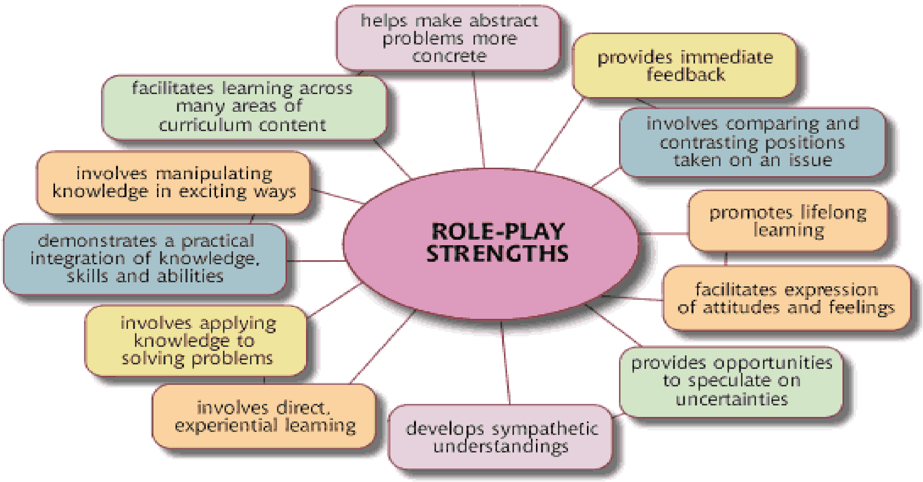

Figure 106: Role-playing as an instructional method for adult learners(autismtherapies.com)

Role-playing focuses on experiential learning theory. According to Dewey (1938), Lindeman (1926) and Kolb (1983) the experiential learning is of great importance. In the same direction Cranton (2009) mentions that "these two concepts – learning by experience and reflection –remain integral elements of all modern-day descriptions of adult education" (p. 9).

Role-playing is the most characteristic version of an experiential learning technique that promotes learning. Students play roles based on a real scenario and have to develop the necessary actual skills which are needed to overcome the difficulties and find the solution to the given situation.

Learner places themselves in another's shoes. Role play should build on the learner's previous knowledge and experience.

Role-playing enables people to experience a situation from the past or to prepare for a future situation.

Role-playing is valuable in learning situations where it is not reasonable to practice the required skills directly in the field. For example, role-playing a public meeting with irate citizens or a child protection worker removing a child from their home.

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1.3.1 Advantages and Disadvantages of Role-Playing

Role-playing comes with advantages and disadvantages.

The advantages of role-playing are:

- It is one of the most active adult-learning techniques.
- It can be used for persons of all levels.
- It promotes active participation by placing emphasis on the process of building knowledge and learning rather than the final outcome.
- It encourages group work and creative interaction among persons.
- It provides a safe setting for the reconstruction of real-life situations, where persons can use taught theoretical concepts.
- It helps persons identify the main stages of a process and realize the differences that surface during the implementation of an activity when initial details change.
- It encourages compassion and sympathy - both of which are likely to be lost during traditional teaching methods.
- It provides direct feedback to the challenges and the misunderstandings faced by the students.
- It does not require the use of special equipment.
- It is a pleasant and invigorating learning technique.
- It helps educators assess the students’ progress based on the expected learning results.

The disadvantages of role-playing are:

- It requires a lot of preparation. Just like all other alternative learning techniques, role-playing requires careful and long preparation to bring a positive outcome.
- It is likely to result in over-simplification of complex situations.
- It is likely to turn the learning process into a simple play game that will sidetrack the whole class.
- If not designed well, role- playing can be boring and not very constructive.
- The results are largely dependent on the skills of the teacher and the participants.
- “Weak” participants may be “too exposed” to criticisms of other participants. They must be identified and protected in advance, accompanying any negative feedback with positive reinforcements.
- A “too strong” trainer can inhibit the spontaneity of the participants leading them not to be completely free and able to manage themselves, whilst a “too weak” trainer leaves the group disoriented with the feeling that no goals has been achieved.

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1.4: Therapeutic Role-Playing (TRP)

Therapeutic role-playing (TRP) is a way to create an imaginary reality in order to objectify experience.

The technique is used in therapeutic settings for many purposes:

- As a diagnostic tool.
- To model ideal behaviour and allow patients to practice skills in a safe environment.
- Development of flexibility skills.
- To gain insight into one's behaviour.
- To help the individual achieve catharsis by re-enacting painful experiences.
- As another therapy channel when an individual refuses to talk about his problems.

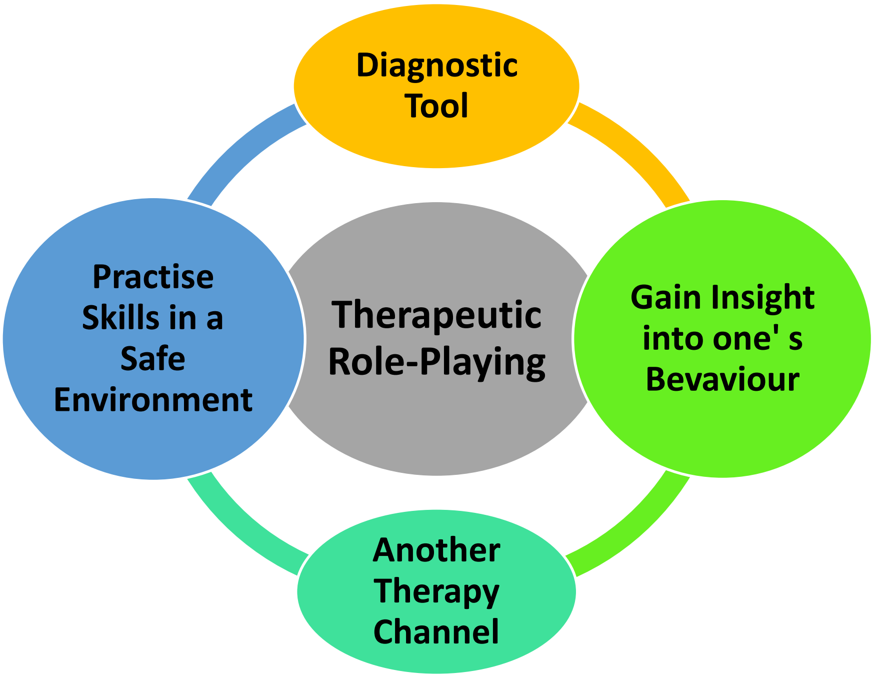

Figure 108: Purposes of Therapeutic Role-playing (Chronicle.com)

Therapeutic role-playing is an independent technique of any therapeutic orientation and for that reason, it can be used by any therapist.

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TRP can be used in order to serve a large amount of purposes. So, *TRP* is used for training social skills, for managing high levels of anxiety and phobia treatment, for managing behaviour and for assertiveness training. Many recent researchers point out the usefulness of role play in the process of designing human-computer interaction systems. Role-playing has been shown to facilitate attitudinal changes more effectively than traditional educational information.

1.4.1 TRP Techniques

There is a wide range of role-playing techniques for the therapist to choose. According to the number of participants these techniques are categorized into solo, dyad, triad and group.

The main TRP techniques are:

THERAPEUTIC ROLE-PLAYING TECHNIQUES

Auxiliary chair technique: Chairs are substituted for the person and/or characters from the person' s life or to externalize the person's psyche. This technique is useful for shy persons.

Behind your back technique: In group therapy, the person (A) discusses problem for 10-30 minutes. A then goes behind a screen and each member is urged to make a comment about the "absent member", then return for discussion.

Doubling: The person (A) sits back-to-back with an assistant (B). The person is asked to talk about her/his problems out loud and B voices her thoughts as her/his alter ego.

Mirror technique: Typically used after a Psychodrama, the person looks as into a mirror while an assistant (D) plays her/his role (A) and the (C) plays antagonist (B).

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Black out technique: The room is darkened but the person acts as if in full daylight. The goal is for the person to go through a painful experience unobserved in privacy, in order to achieve catharsis.

Soliloquy technique: The person turns to one side and expresses her/his thoughts and feelings in a voice different than she normally uses.

1.5: Play and Learning

Educators are re-thinking how to teach people to tap their enormous learning potential. Play is one of the most important ways in which young children and adults gain essential knowledge and skills. The next section of this brief explains what is meant by play and play-based learning and gives examples of the many ways in which children and adults learn through play (Education Comission, 2017).

Play takes many forms. Everyone knows 'play' when they see it – on streets, in villages, on playgrounds, in classrooms. People from every culture, economic background and community

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engage in play from their earliest years. Yet, play can be hard to define. Researchers and theorists, however, agree on the key characteristics of playful experiences. An important aspect of play is a person’s agency and control over the experience. Agency refers to a person’s initiative, decision-making and self-choice in play. Ultimately, play should involve some degree of agency, enabling people to take on an active role and ownership in their experiences, as well as recognizing and trusting persons to be capable, autonomous, and agents of their own playful learning journeys (The Lego Foundation, 2012).

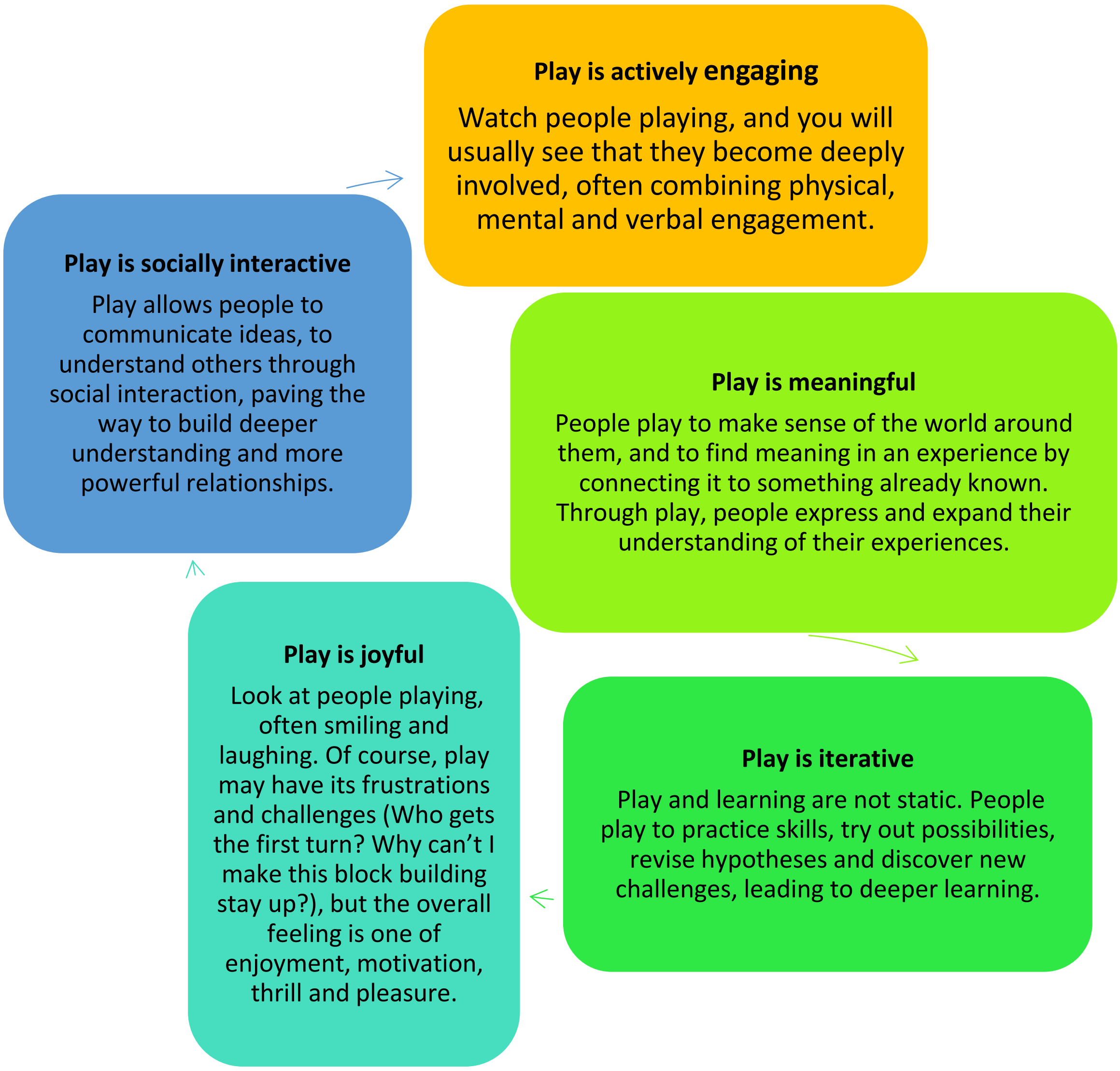

Figure 109: Key characteristics of playful experiences (UNICEF, Lego Foundation)

Development and learning are complex and holistic, and yet skills across all developmental domains can be encouraged through play, including motor, cognitive and social and emotional skills. By

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choosing to play with the things they like to do, people actually develop skills in all areas of development: intellectual, social, emotional and physical.

Play sets the foundation for the development of critical social and emotional knowledge and skills. Through play, people learn to forge connections with others, and to share, negotiate and resolve conflicts, as well as learn self-advocacy skills. Play also teaches people leadership as well as group skills. Furthermore, play is a natural tool that people can use to build their resilience and coping skills, as they learn to navigate relationships and deal with social challenges as well as conquer their fears, for example through re-enacting fantasy heroes.

More generally, play satisfies a basic human need to express imagination, curiosity and creativity, which are key resources in a knowledge-driven world. They help us to cope, to find pleasure, and to use our imaginative and innovative powers. Indeed, the critical skills that people acquire through play in the preschool years form part of the fundamental building blocks of future complex “21st-century skills” (National Scientific Council on the Developing Child, 2017).

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Topic 2: Social skills, Life skills and the Importance of Self-Regulation

2.1: What are Social Skills?

Sociability and successful relationships greatly affect a child's self-confidence and accompany him or her into adulthood. Social skills are a set of skills that enable one person to communicate, interact and socialize with others successfully.

Social skills are used to communicate with others daily in a variety of ways including verbal, non-verbal (through gestures, body language and our personal appearance) written and visual. Social skills are also referred to as interpersonal or soft skills (e.g., empathy, cooperation, respect, effective communication, etc.).

Verbal skills involve the spoken language, while nonverbal communication includes body language, facial expressions and eye contact. Any time you interact with another person, you're using social skills in some way. Strong social skills can help you build and maintain successful relationships professionally and personally.

The skills required for successful social reconciliation are:

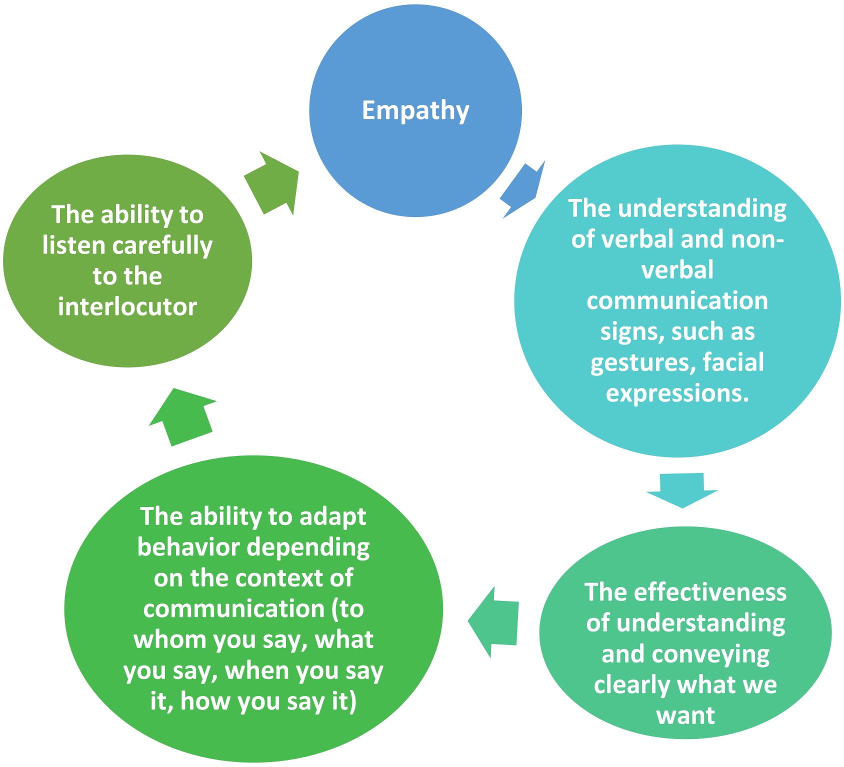

Figure 110: Skills required for successful social interacting (psychomotor-athens.gr)

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2.2: Why are Social Skills Important?

Social skills are important because they can help people communicate more effectively and efficiently and, as a result, help them build, maintain and grow relationships with colleagues, clients and new contacts alike. Displaying good manners, communicating effectively with others, being considerate of the feelings of others and expressing personal needs are all important components of solid social skills.

These skills are important to maintain and improve no matter your position, industry or experience level.

Social skills are all the core skills you learn about getting along well with others. Social skills are really important for everybody so we can treat each other with courtesy, respect, honesty, and kindness. To understand why social skills are important for people, think about what life would be like without them. What if kids didn’t wait their turn? What if people grabbed things from each other's hands? What if people lied to get what they wanted? What if people blurted whatever words popped into their heads? What would happen if you couldn’t tell if someone was happy or angry? Without social skills, people would often be really confused or even angry. Using social skills is how we try to live and work together with peace and kindness.

Social skills are also important for future success. Some experts argue that teaching people good social skills is as important as teaching math and reading because the skills are such an essential part of getting along in the world. The study of Emotional Intelligence or Emotional Quotient (EQ) is showing how important social skills are for adults at work and at home. EQ helps people to cooperate and get things done with each other and it helps people connect and have deeper relationships.

Figure 111: The importance of Social Skills (talkingtreebooks.com)

2.3: Life Skills' Education

The World Health Organization (WHO) recognized the usefulness and effectiveness of the skills programmes and stressed that:

*“**Life Skills Education** focuses on developing capabilities and enabling individuals to deal effectively with the demands and challenges of everyday life”* (WHO, 1993).

As basic Life Skills are considered:

- decision-making ability (i.e., the ability to select between two or more alternatives to reach the best outcome in the shortest time);

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- problem-solving ability (i.e., being able to identify and define the problem, generating alternative solutions, evaluating and selecting the best alternative and implementing the selected solution);
- ability to think creatively;
- ability to think critically;
- ability for effective communication;
- ability to develop and maintain interpersonal relationships;
- self-knowledge;
- capacity for empathy; and
- ability to manage emotions and stress (WHO, 1993).

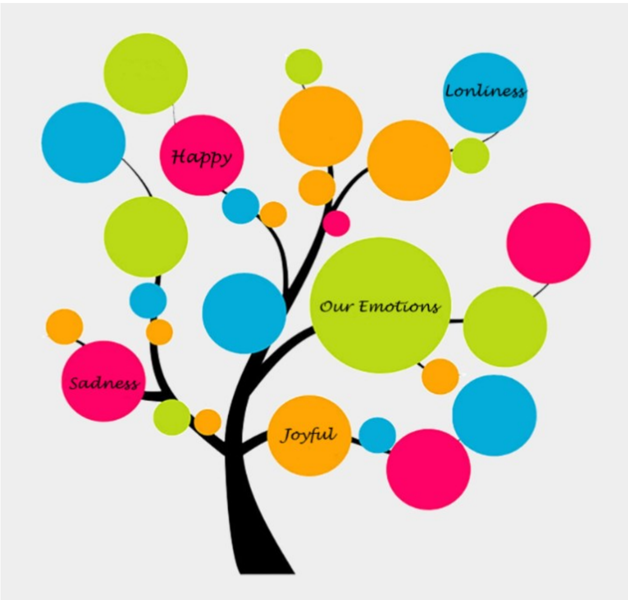

Figure 112: Life Skills' Tree (British Counci.gr)

2.4: Definition and the Importance of Self- Regulation

Self-regulation is considered one of the most important factors in education. There are several definitions, but the main point on which they focus is the modification of behaviour by the individual himself, in order to achieve a goal (Georgiou, 2019). It is a complex skill and incorporates cognitive, volitional, behavioural characteristics, while it is considered an important developmental achievement (Karageorgiou, 2015). More specifically, it involves controlling one' s behaviour, emotions and thoughts in the pursuit of long- term goals.

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Figure 113: Self- Regulation. The ability to Adjust… (team4kids.com)

According to Bandura's definition (1977), self-regulation is divided into three processes: self-observation, self-evaluation and self-reaction. From the point of view of this socio-cognitive theory, the two dimensions of self-regulation concern the study of the goals set by the individual and the design of a plan in order to achieve them (Karageorgiou, 2015).

People who have mastered it, set learning goals, organize their material, process information more easily, coordinate the strategies needed to achieve the project, interpret and plan and control their available time (Karageorgiou, 2015).

Self-regulation skills can be used to regulate our emotion (self-control), our behaviour, in lessons such as math, reading, problem solving and can be acquired by students with learning disabilities, intellectual disability (formerly, mental retardation) or autism. According to Cooper (2009), self-regulation offers autonomy to the individual, so that from childhood he can act independently.

Dehnam (1998) considers self-regulation to be related to the expressiveness, understanding and socialization of the individual, while Thomson (1990) considers it as a form of controlling behaviour, emotion, thought and attention. A person who has self-regulation, is able to control his emotion and behaviour and to enter into a healthy relationship with his peers (Skarlatos, 2013).

Also, according to the theory of emotional intelligence by Goleman, self-regulation is one of the five components of this kind of intelligence suitable for controlling one's emotion (Ackerman, 2019).

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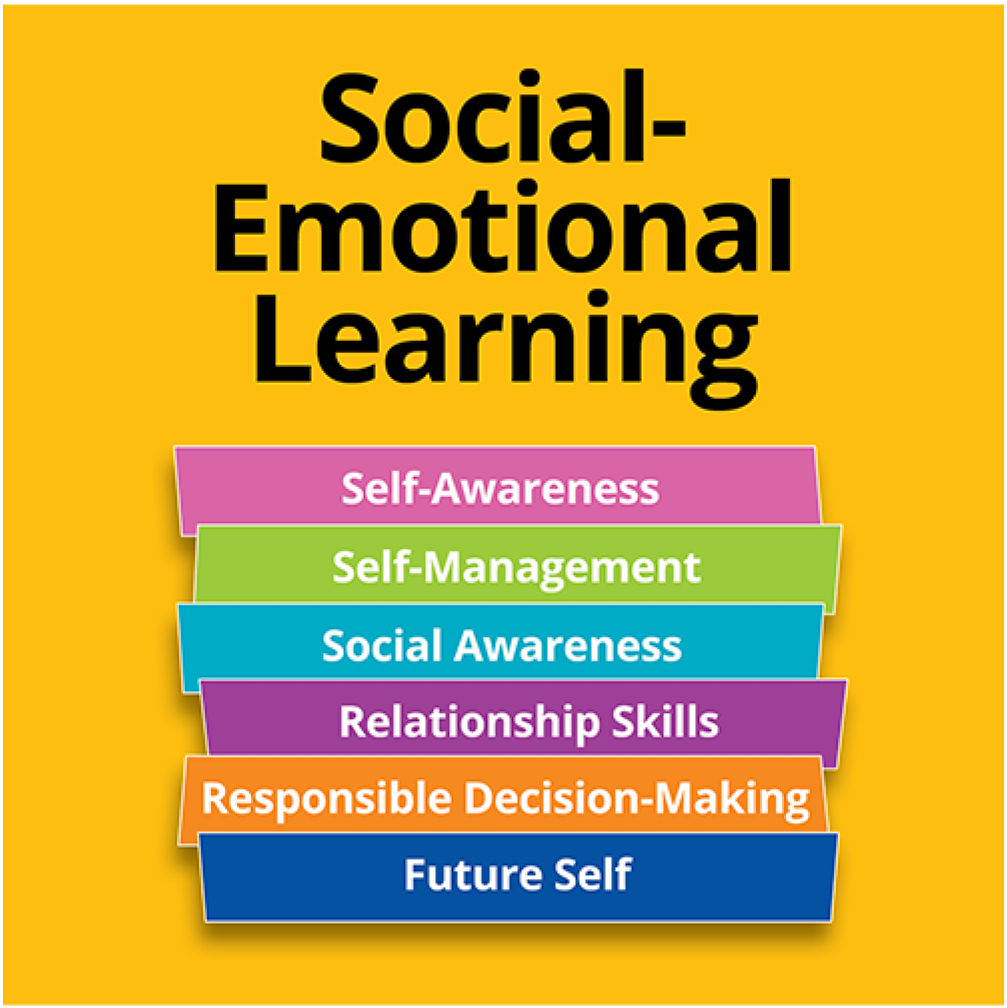

Figure 114: https://www.pbslearningmedia.org/

A very interesting video for Self-management from PBS LearningMedia:

https://www.pbslearningmedia.org/resource/self-management-video/social-emotional-learning/.

2.5: Persons with Disabilities and Mental Health Problems

Nearly everyone faces hardships and difficulties at one time or another. But for people with disabilities, barriers can be more frequent and have greater impact. The (WHO, 1994) describes barriers as being more than just physical obstacles, defining them as:

> "Factors in a person's environment that, through their
>
> absence or presence, limit functioning and create disability.
>
> These include aspects such as:

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- a physical environment that is not accessible;
- lack of relevant assistive technology (assistive, adaptive, and rehabilitative devices);
- negative attitudes of people towards disability; and
- services, systems and policies that are either nonexistent or that hinder the involvement of all people with a health condition in all areas of life".

2.5.1 Autistic Spectrum Disorder and Intellectual Disabilities

According to the American Psychological Association (*APA*, 2013):

"Autism spectrum disorder (ASD) refers to a neurodevelopment disorder that is characterized by difficulties with social communication and social interaction and restricted and repetitive patterns in behaviours, interests and activities. By definition, the symptoms are present early on in development and affect daily functioning. The term 'spectrum' is used because of the heterogeneity in the presentation and severity of ASD symptoms, as well as in the skills and level of functioning of individuals who have ASD".

American Association on Intellectual and Developmental Disabilities (AAIDD) and the Diagnostic and Statistical Manual on Mental Disorders (DSM) define Intellectual Disability as:

"A developmental condition that is characterized by significant deficits in both intellectual functioning and adaptive behaviour, including conceptual, social and practical skills ".

(APA, 2013. Schalock et al., 2010).

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Children and adults with neurodevelopment disorders have a deficit in social understanding, defined as the skills that permit people to understand and infer our and others' mental states, such as intentions, desires, and emotions (Carpendale & Lewis, 2004; 2006; Dunn, 1988). Consequently, they are unable to think and act appropriately in order to succeed in social interaction with others and to build relationships with peers or other people. However, social interaction is a fundamental principle in our lives. Everyday situations and events push us to interact with others, but children and adults with autism and intellectual disability do not act properly in social situations, and this is because they fail to understand that others may have a different thought from them. They believe that the actions of others happen without meaning, purpose and logic, and fail to understand how other people can

2.5.2 Social Stories

An approach to teaching ***social skills, life skills and self- regulation*** is the Social Stories developed by Carol Gray (2010), who after twenty years of personal experience, working directly with children

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with ASD, has set the guidelines to create social stories, which are based on the feedback from parents, teachers and children themselves (Gray, 2010).

Social Stories describe a situation, skill or concept in terms of relevant social cues, perspectives and common responses in a patient and reassuring manner that is easily understood by its audience" In other words, social stories use words or images to explain specific occurrences, behaviours, social interactions, concepts, or skills. They are designed to benefit those with developmental delays, social issues, autism, or other difficulties with comprehension (from https://carolgraysocialstories.com/social-stories/what-is-it/2).

A Social Story describes a social situation as perceived by the PWD and not by a typically developing person. So, its use can be beneficial for both parties, as it helps both the PWD and the typically developing ones to understand the perspective and the unique way a PWD perceives social reality (Alevra, 2007).

The aim of Social Stories is not only to educate PWD with appropriate social skills, but also to develop social understanding and to share information about: "when", "where" a situation takes place, "who" is involved, "what" happens and "why" (Howley & Arnold, 2005).

Social stories provide PWD with lost information about the prospects of others and about social signals. Providing missing information helps to clarify the whole social picture. They provide accurate social information, allowing access to the secrets surrounding social interaction and practically tangible social information (Howley & Arnold, 2005).

Social stories could be used to introduce changes and new routines at school, at home or to explain the causes of others' behaviour, so could:

- Prepare the person for new events and experiences, e.g., family vacation, visit to the doctor.
- Teach him/her a positive behaviour, e.g., shopping with mom in the supermarket.
- Teach him/her a new skill, e.g., how to wash my hands.
- Teach specific social and communication skills.
- Help manage change.
- Reduce stress.
- Help manage repetitive behaviours.
- Help deal with school curricula.

Here is "Choosing what to wear Social Story":

https://drive.google.com/file/d/1rXCeM6k1r-dmbg6jvbkVgrW7u78PosJ-/view
(https://www.andnextcomesl.com/)

2.5.3 From Social Stories to Video Modelling

Video-modelling (VM) is **another way to teach new skills or behaviour to PWD**. The video shows someone doing a skill or behaviour. The person watching the video copies the skill or behaviour.

There are **four types of VM**:

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- Basic video-modelling: this uses other adults, peers or animation as models.
- Video self-modelling: this uses the autistic person as the model.
- Point of view video-modelling: this shows what completing the task would look like from the person's point of view. For example, the video shows a pair of hands doing a task.
- Video-prompting: this breaks up a task like brushing teeth into steps that the person watches as they complete the task.

We can watch a video about "Starting a conversation" through VM:

https://www.youtube.com/watch?v=QuukBPccAeE

VM is used to help both PWD learn new skills like social communication, play and daily living skills and change their behaviour. VM is based on Albert Bandura's social learning theory (1977). According to which, people learn from each other by watching and copying.

For persons with autism, VM seems to be more motivating and less threatening than face-to-face modelling. It also lets PWD focus on one aspect of a skill or behaviour at a time. They can watch the video as many times as needed to learn the skill (https://raisingchildren.net.au/autism/therapies-guide/video-modelling). The incorporation of an enjoyable activity, such as watching a video, into classroom teaching may be more motivating, with increased attention being paid to the video, increasing the likelihood of learning or imitating the modelled activity (Alzyoudi et al., 2014).

Another video modelling as concerns the "Appropriate Greetings":

https://www.youtube.com/watch?v=KAsgrFxtmSA

At next topic, we will present the Virtual and Augmented Reality methods, as the latest strategies for better educational results as far as concerns the reinforcement of Social Skills of PWD.

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Topic 3: Virtual Reality and Augmented Reality. Ethical Challenges.

3.1: Definitions

3.1.1 Definition of Virtual Reality (VR)

Virtual Reality (VR) refers to a computer-generated simulation in which a person can interact within an artificial three-dimensional environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors. In this simulated artificial environment, the user is able to have a realistic-feeling experience. The concept of VR is built on the natural combination of two words: the virtual and the real. The former means "nearly" or "conceptually," which leads to an experience that is near-reality through the use of technology. Software creates and serves up virtual worlds that are experienced by users who wear hardware devices such as goggles, headphones, and special gloves. Together, the user can view and interact with the virtual world as if from within.

Figure 115: Image taken from https://learn.g2.com/virtual-reality

3.1.2 Definition of Augmented Reality (AR)

Augmented reality (AR) is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology. It is a growing trend among companies involved in mobile computing and business applications, in particular. AR is a technology where digital information (images, audio, text) is superimposed on the real world, either with mobile devices or headsets and glasses. AR is emerging as a promising technology to help those with ASD understand the world more fully by bridging the physical and digital worlds. We’ve done some digging into the impact of AR on ASD, and research shows its effects to be positive in a variety of situations. AR can encourage play and improve language, communication, emotion identification and vocabulary. Results also indicate benefits like increased motivation, attention, and the learning of new tasks. AR is also used in rehabilitation, especially for the treatment of phantom limb pain (Carrino et al., 2014. Rutledge et al., 2019).

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We can watch a video in order to understand how AR works for PWD:

https://youtu.be/SA2ZMjqat5c (https://spellboundar.com/blog/augmentedrealityandautism)

3.1.3 The Impact of AR for Persons with ASD

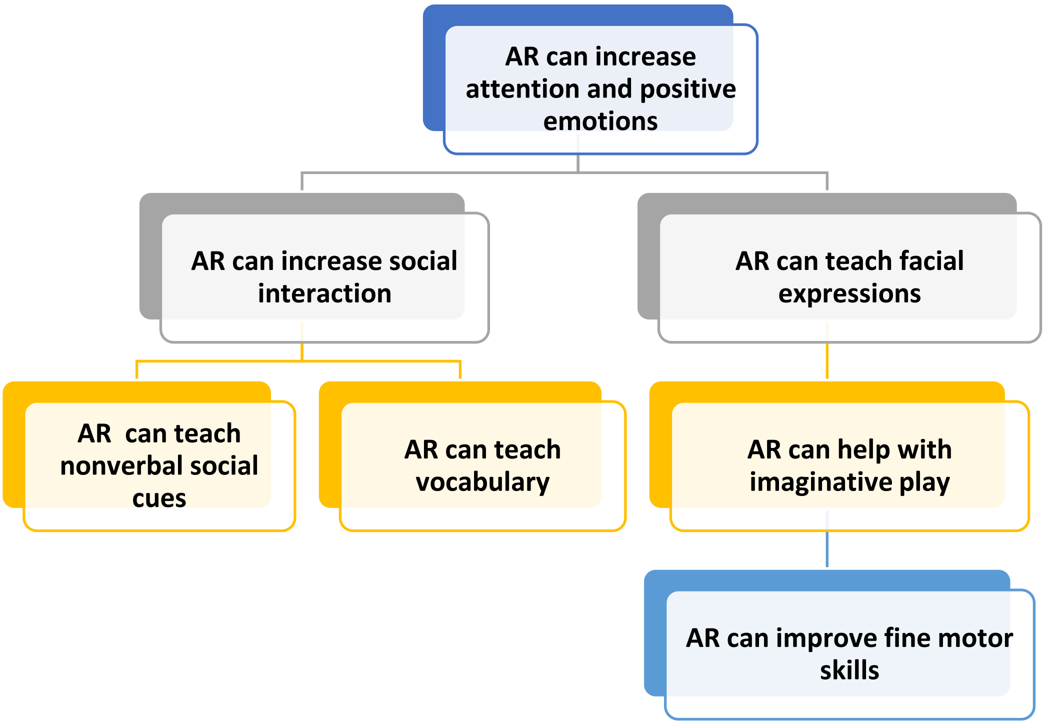

Figure 116: https://spellboundar.com/blog/augmentedrealityandautism

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3.2: The Advantages of VR and AR for PWD

Nowadays, AR and VR technology have been examined and found to be a useful tool in the psychoeducational context. As logically emerges both have been used in various settings with beneficial results. It is worth to mention that the more characteristic difference between VR and AR is that the VR takes place completely in a virtual environment emphasizing the experience of simulation, while AR includes real objects with the emphasis given in the interaction with these objects in the actual world.

Individuals who face difficulties in cognition and behaviour could be supported by the Virtual Learning Environments (VLE), as the interactive learning gives them the chance to have control on the learning process, focusing on their abilities and learning preferences (Pantelidis, 1993. Rizzo et al., 2001). The use of virtual technology in the field of Special Education, in order to assist in a therapeutic context, the PWD is of great interest.

Specifically, the various VLE are found to be effective in different areas of disability, supporting significantly the individuals who use them.

- At first, in case of moderate and severe disability the use of VLE is considered to be effective due to its beneficial characteristics, such as the flexibility and simplicity combined with the low physical effort it demands and also the tolerance to error (Jeffs, 2009). They also provide the users with the ability to repeat the tasks and have the control of the learning process in which they are involved (Standen & Brown, 2006). In general, when they are designed appropriately, they promote the safe exploration, the control and the acquisition of the desired learning outcomes (Braddock, Rizzolo, Thompson & Bell, 2004).

- Regarding learning disabilities, the aforementioned environments create realistic scenarios of real-world situations, supporting the users to overcome the difficulties they face by developing new skills and at the same time being less dependent on the written and oral information (Jeffs, 2009).

- Similar positive therapeutic outcomes may arise by using virtual technology in order to strengthen the academic abilities and the social skills of individuals diagnosed with Attention Deficit/ Hyperactivity or behavioural disorder especially in an educational context. The aim in case of behavioural disorders could be to equip those students with the necessary social skills, such as the problem solving or the decision making by practicing them in a safe virtual environment while regarding Attention Deficit/ Hyperactivity disorder the target could be the development of attention and safety skills through a simulated and realistic environment (Jeffs, 2009).

- Similar effects seem to exist as for the sensory impairments in vision, touch or hearing. VR could promote the development of cognitive skills which enable the individuals to interact with their environment in different manners. The aim could be to learn taking advantage of other environmental stimuli in order to determine their environment. More specifically, in case of vision deficiency the sound stimuli are of particular importance while in hearing

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impairments the visual and audio. In both situations the VR environment may be beneficial by providing the necessary inputs and outputs and enhancing the problem-solving skills, the attention and the confidence of those individuals (Jeffs, 2009).

ASD constitutes a noteworthy issue. In children it is associated with deficient social and communication abilities that may hinder the learning process as it occurs from social interaction and peers' relationships. Reluctance to change, persistent routines, sensory sensitivities and adaptive skills typically below measured IQ are also existing. As adults many have difficulties establishing independence due to the aforementioned rigidity and difficulty with innovation (APA, 2013). Therefore, it is very important to develop new appropriate interventions through technology in order to help them deal effectively with these difficulties.

Studies in this field suggest that VR compose probably an effective tool responding to the needs of the individuals with ASD in psychoeducational context varying from emotional skills to social adaptation training (Ip et al., 2018. Bekele et al., 2014. Smith et al., 2014). In the same direction Cobb (2007) emphasized the fact that VLE could operate by promoting the independence and supporting the necessary communication skills for persons diagnosed with ASD. Additionally, it is suggested that the learning process is better achieved by the combination of words and pictures rather than by the words exclusively making VR a possible effective mean of intervention (Mayer, 2002).

Respectively, according to Parsons and Mitchell (2002), VR could promote the acquisition and training of social skills through the safe and controllable environment that it provides. They focused on the key role that the repetition of tasks in a specific context before moving to a different, plays for the effective practice of social rules and the simplify of building learning routines process.

To sum research findings supports the fact that VR possess beneficial effects for individuals with ASD in domains such as the acquisition of social skills and knowledge and their transfer from the virtual world to the real, the improvement of executive functions, the management of specific anxiety and the development of the necessary for the learning process safety skills (Charitos et al., 2000. Jeffs, 2009. Kandalaft et al., 2013. Matsentidou & Poullis, 2014. Parson & Mitchell, 2002. Rothbaum et al., 2006).

AR technology establishes an additional intervention method for the social training of autistic children which is constantly developing. The advantages of AR are observed in various domains such as supporting those individuals to figure out and express their feelings as well as to be aware of their social status through the process of pretend and symbolic playing and by watching things form a different perspective (Huang & Lee, 2019. Ip et al., 2018). Given their deficits regarding the use of imagination, AR could be useful for by providing them with visual information of objects and environments which is considered to be more effective for the teaching than the words or images solely (Dragomir, Manches, Fletcher-Watson & Pain, 2018).

In addition to the above, empathy constitutes also an important issue. According to APA it is defined as the ability of “understanding a person from his or her frame of reference rather than one’s own, or vicariously experiencing that person’s feelings, perceptions, and thoughts”. This process is decisive for the establishment of relationships in the social context and is considered innate to the typical children. The understanding of another’s feelings requires transpositional thinking and subsequently provides the ability of predicting and adopting the behaviour representation (I-Jui

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Lee, 2019. Knapp, Hall & Horgan, 2013). In typical language development, the understanding of symbolic language takes place in childhood. In people with autism there is a clear delay in the development of these skills. Is observed limited mental flexibility and for this reason only the literal meaning is given to the words, without it being possible for people with autism to process idioms or to understand humor and sarcasm (Attwood, 2005). Metaphors are the pre-eminent factual expression of symbolic language and are directly related to the cognitive process (Vulchanova et al., 2015). Many studies have repeatedly found that autistic children are unable to understand the autistic dimension of language and symbolic language in general (Tzuriel & Groman, 2017).

This communication process is mainly based on non-verbal prompts, so it becomes extremely difficult for children with autism. AR technology could be helpful in strengthening the empathy skills and promoting the transpositional thinking (Chen, Lee & Lin 2015. I-Jui Lee, 2019).

In overall, AR technology could produce a wide range of therapeutic outcomes for the children and persons with autism especially in terms of social skills training, transpositional thinking, symbolic and role-playing, enhancement of attention, expression of thoughts or emotions and also achieving empathy (I-Jui Lee, 2019).

3.3: Life Scenarios and Applications of VR and AR to PWD

Virtual Reality/Augmented Reality

Virtual and Augmented Reality offer advantages that can be used effectively in the learning process of social and everyday life skills and abilities in the field of special education and disability upgrading the quality of user's life. These learning environments give them the opportunity to obtain information, to learn and practice social skills and to use them in the real world. Below are mentioned hypothetical case studies and life scenarios, in order to emphasize the utility of the aforementioned learning environments.

Life scenario/case study No 1 (Virtual Reality/social skills)

Name: ---------------
Gender: Female
Age: 45 years old

Disability: ASD and Intellectual Disability

Description: She does not seek the communication with others and face difficulties in establishing relationships. She prefers listening music alone and is interested in technology. She is high functioning but also manifests repetitive patterns of behaviour and gets upset when her daily routines change. She also faces difficulties when she has to wait her turn or is needed to remain in a place for a certain period of time.

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***The scenario is hypothetical and does not refer to anyone in particular**
The VR environment could support the development of the necessary communication skills and her independence. The virtual representation of a daily situation such as a visit in a Café could help her perform appropriately specific tasks like finding a table, ordering something to drink, understand the behavioural norms and be patient. These tasks could be achieved through the interaction with virtual objects and avatars giving her the chance to learn by asking the appropriate questions, interpret the responses and accept the social norms. The aim of the aforementioned procedure will be the transfer of the skills learned in virtual environment to the real-world daily situations.

Life scenario No 2 (Augmented Reality/everyday life skills)

Name: -------------------------
Gender: Male
Age: 40 years old
Disability: Intellectual Disability

Description: He has a lot of friends. He does independently some daily living activities except from making his bed and managing his money. He is familiar with the use of technology and smart phones.

***The scenario is hypothetical and does not refer to anyone in particular**
The AR environment could support him to acquire or improve the daily living skills which are considered of low level. This could be achieved by the combination of video modeling, an AR application and a device aiming in his effective training. In that case also the AR learning environment can be used as tool in order to make the individual more independent and functional.

3.4: Ethical Challenges and Issues on VR and AR

It is undeniable that the evolution of technology is associated with significant benefits but also raises important ethical questions which should be carefully considered. VR and AR play a key role in the aforementioned evolution and constitute important accomplishments which except from their beneficial uses are also correlated with social and ethical issues including physiological and cognitive impacts. The fact that differentiates VR and AR is that in the latter the interaction takes place on the real-world face to face with digital information, while VR provides an entirely new virtual environment for the interaction. The aforementioned ethical implications should be controlled by guidelines, laws and also in practice (Kenwright, 2018).

As the literature suggests, there are important issues which should be under consideration regarding the use of VR and AR. To be more specific the following should be noted:

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- There is the possibility for the user to relieve negative feelings such as anger by the representation of psychologically painfull or unsolved situations (Wassom, 2014. Madary & Metzinger, 2016. Slater et al., 2020).
- The persuasiveness of this kind of technology combined with the difficulty in predicting its short and long-term effects. These characteristics arise ethical questions about their correct or incorrect use and beneficial or not purposes (Wassom, 2014. Madary & Metzinger, 2016. Slater et al., 2020).
- Regarding the privacy and the data protection it should be noted that this issue needs to be considered carefully. The personal data that may be collected must be protected from being hacked or used for inappropriate purposes (Wassom, 2014. Madary & Metzinger, 2016. Kenwright, 2018. Slater et al., 2020).
- As for the social dimension, the long-term use of VR and AR may lead to the dominance of the virtual world towards the real. This could affect negatively the functional engagement with others in the real world (Gutek, 2013. Kenwright, 2018).

- Confusion and difficulty in distinguish between the virtual experience and the reality, especially in children and adults is also noteworthy (Kenwright, 2018).
- The physical domain includes health issues which should be under consideration in order to ensure the safety of the users. Diziness and accidents related to the equipment constitute typical examples (Behr et al., 2005).
- The impact of specific characteristics, such as the age of the users, should also be noticed. Particularly the correlation of the age with factors such as the digital awareness, sensitivity in mental health domain and the overall experience could be important (Kenwright, 2018).
- In case that the VR is used for therapeutic purposes there is the possibility for the user to face difficulties in exiting from the virtual world especially if in this world he is living with a desirable virtual body. This could result to adverse outcomes at the end of the therapeutic process (Wassom, 2014. Madary & Metzinger, 2016. Slater et al., 2020).

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- Regarding the psychological dimension, the designers of VR and AR products should concern their possible correlation with situations such as the post-traumatic stress disorder, desensitization to violence, and decreased empathy (Behr et al., 2005).

In conclusion according to Behr et al. (2005) the possible risks in VR and in some cases in AR use could be categorized as follow:

- Motion/physical sickness
- Information overload
- Expansion of experience
- Cognitive, emotional and behavioural disturbances during the return to the real world after the virtual experience

The designers of VR and AR products should be useful to consider the aforementioned ethical implications and issues in physical, emotional and social domain, especially when their products are designed for educational purposes and are intended for use by children, adults or PWD. These aspects should also concern the caregivers and the professionals working with persons with disabilities.

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Summary:

- A social skills intervention tool, which might pair well with social stories, is role-playing. Role-playing is an intervention in which skills are practiced by acting out a social situation and has shown success when used both as an aid as well as an exclusive treatment for improving social skills.
- Life skills is a term that describes a set of skills acquired through learning and/or through one's experience and used to help individuals and groups effectively manage everyday problems and issues.
- Self-regulation is the ability to monitor and manage PWD energy states, emotions, thoughts, and behaviour in ways that are socially acceptable and produce positive results such as well-being, loving relationships, and learning. It is how we deal with stressors and as such, lays the foundation for all other activity. Developing this ability requires self-awareness, emotional intelligence, efficient filtering of sensory stimulation, coping effectively with stress, relating well to others, and sustaining focus.
- Although most persons within the high-functioning autism spectrum have above average intellectual capabilities, they often experience social difficulties. Deficits in social communication and difficulty inhibiting thoughts as well as regulating emotions, can lead to social isolation and low self-esteem. Virtual reality training programme is producing positive results. Participants who completed virtual reality training programmes demonstrated improved social cognition skills and reported better real-world relationships.
- Augmented Reality technology provides an interesting and fun learning environment, changing the way we teach persons within the ASD, and the way they learn, and therefore more efficacious.
- Several studies suggest promising findings about the effectiveness of Augmented Reality-based treatments for the promotion, support, and protection of health and wellbeing in children and adolescents with ASD.
- Virtual and Augmented Reality technologies are increasingly finding foothold in culture and society. As these technologies stake out an increasingly large space in areas like entertainment, work, health and communication, it is important that we are equipped to think lucidly about both their benefits and their drawbacks.

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Learning Evaluation:

A. Self-Assessment Questions:

Question 1 – Which of the following does not affect the learning process?

a. Active participation
b. Individual study
c. Purposeful activities
d. Collaborative practices
e. All the above

Question 2 – In which the areas therapeutic role-playing is most useful?

a. As an alternative therapy channel when an individual refuses to talk about his/her problems.
b. As a standalone tool for acquiring life skills.
c. To model ideal behaviour and allow patients to practice skills in a safe environment.
d. To help the individual achieve catharsis by re-enacting painful experiences.
e. All the above.

Question 3 – Emotional Intelligence study shows the importance of social skills in everyday activities. On which areas social skills have minimum or no impact?

a. Intrapersonal communication
b. Future success
c. Interpersonal interaction
d. Personal growth
e. None of the above

Question 4 – In recent years, Virtual Reality has proven its usefulness as a training tool in the field of disability. What are the advantages of VR that makes it such a useful tool?

a. Flexibility and simplicity of scenarios
b. Low physical effort
c. Increased social interaction
d. Controlled and realistic environmental stimuli
e. Facilitation of problem solving and decision making

Question 5 – When using technological aids in training, such as Virtual and Augmented Reality tools, which ethical considerations should not be taken into account?

a. Dominance of the virtual world towards the real
b. Personal data of the end user
c. Cost of technological aids

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d. Reduced empathy
e. Self-image issues

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B. Activities:

Activity 1 – Role-Playing

Role-playing:

- Discuss possible role-playing scenarios with the use of Augmented Reality in your organisation.
- How do you believe that it would affect your clients and beneficiaries?

Activity 2 – Virtual Reality

- Create a real-life scenario involving the transition of a PWD, from their current routines to the appropriate behavioural norms on their own Supported Living Flat using Virtual Reality.
  - Describe the necessary steps of the scenario: "After-bathroom appropriate behaviour".

Activity 3 – Ethics

- Discuss the advantages and disadvantages of VR & AR regarding PWD.
  - What we gain and what we should be aware of?

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Conclusions

Concluding Remarks for Unit 1 – New Technologies:

In the field of Assistive Technology, digital devices and applications play an increasing role. Apps support health monitoring and control of smart devices. Intelligent solutions improve the control of devices, (e.g., through speech or written word recognition for people with visual or movement impairments). Due to accessibility standards, common devices like smart phones or tablets offer additional possibilities, such as enlarging or reading aloud text.

With the help of smart home applications, independent living can be made safer. Falls and deviations from daily routines can be detected and help requested, if necessary. In the future, robotic systems will be able to support clients to reach more independence from external help and caregivers by taking over tasks whose time can be used for other things.

With all these advantages, there are some aspects that need to be considered, such as data and privacy protection and the impact on personal relationships and working conditions. But also ecological sustainability should be considered, as digital applications cause high energy consumption. Savings are possible here through informed selection and use.

Increasingly, research evidence is highlighting the utility of Virtual Reality and Augmented Reality within skills teaching for individuals with autism spectrum disorder and Intellectual Disabilities. Positive outcomes have been demonstrated for a variety of social communication and functional living skills, across contexts, and utilising different applications of Virtual Reality and Augmented Reality. Within the context of teaching social communication and functional living skills, Virtual Reality and Augmented Reality can provide unique benefits and advantages to support learning, nevertheless it is important to be mindful of the potential challenges that could arise for individuals with autism spectrum disorder and Intellectual Disabilities and to consider them at the outset when planning a teaching programme.

Brain-Computer Interface represent a promising innovative technology to allow people to communicate and interact with the environment throughout the interpretation of specific brain signals. Since they do not require neuromuscular activity, BCIs can provide a communication channel to persons with severe motor disabilities and support neurorehabilitation. Today, there are few examples of BCI systems available for end users, but BCI research is currently focused on turning BCI into an AT input device for full integration into AT centres' portfolios.

Concluding Remarks for Unit 2 – Self-Advocacy and Technology Acceptance:

Self-advocacy is both a relevant set of skills and a movement that every person working in the field of disabilities should know about.

Self-advocacy is, in fact, very important when talking about people with disabilities' rights and independence.
Not only did self-advocacy prove to be a means for making better various aspects of the lives of people with disabilities, such as their independence, happiness, involvement, participation and

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engagement in life, which have positive impacts on their wellbeing, but it can also be useful for enhancing the job of assistants and other workers as well as the lives of the families and relatives of people with disabilities.

In the same way, self-advocacy promises to make the process of care and assistance smoother, as the persons' independence is strengthened and improved.

Combining self-advocacy's broader advantages with the potentials of the new technologies' supportive devices, we can imagine how more economically sustainable the process of assistance may become, as it may be both less required and less demanding for the personnel.

Both from the point of view of technologies and from that of self-advocacy training it may be said that an initial effort should lead to a series of enhancements in the face of a reduction in terms of costs: people working in the care and assistance sector would indeed be benefited from the help of technology and that of a more self-determined person to assist, which would reduce both the risk of burnout and overload and the time needed to accomplish certain tasks.

Concluding Remarks for Unit 3 – Social Networks' Development:

The topics and subtopics of the Social Networks Development Unit were chosen by practitioners (social workers, andragogues) who work directly with PWD (Persons With Disabilities) (in Lithuania). They are well aware of what knowledge they lack, what information they cannot find through information sources, and what they want to learn. Professionals are also well aware of the difficulties faced by PWD and the needs of PWD (both individual and general) in this topic. The learning content have been developed using practical, non-theoretical learning methods. Practitioners agreed that there was a severe lack of practical skills and competences. Therefore, the content of this Unit is based on practical rather than theoretical learning. Practitioners also highlighted that it is difficult to find the latest literature in their own language and even more difficult to get access to the latest assistive technologies. Without access to technology, theoretical learning becomes meaningless to them.

Concluding Remarks for Unit 4 – Therapeutic Role-Playing:

Imitation of role models is a necessary prerequisite for the development of social skills.

Role-playing gathers all the elements that can put the person in a position so that s/he has to play a role-model. Role-playing is considered an effective therapeutic procedure through which persons could cultivate their self-esteem, reinforce their social skills, be educated in life skills and at last, facilitate the understanding and acceptance of the others.

In addition, therapeutic role-playing has proved to demonstrate similar positive therapeutic outcomes regarding persons with disabilities. Virtual learning environments produce important outcomes in terms of improving the necessary social skills and enhancing self-advocacy and independence of persons with disabilities. As in every aspect of technology, Virtual Reality and Augmented Reality should be in agreement with ethical issues, which ensure their appropriate use and the benefits they provide to the users.

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General Conclusions

The DDSkills project has developed a Training Handbook for professional caregivers, consisting of 4 core training Units (1. New Technologies, 2. Self-Advocacy and Technology Acceptance, 3. Social Networks’ Development and 4. Therapeutic Role-Playing). Each Unit focuses on promoting the independency of the beneficiaries of these professionals (people in the autism spectrum and people with intellectual disability) and on the development of their quality of life.

More specifically, the unit on new technologies (1) focused on the use of cutting-edge technologies, such as Robotics, Smart Home, Augmented and Virtual Reality, Brain-Computer Interfaces etc., in order to support the services provided by the caregivers in the areas of accessibility, promoting independence and usage of user-friendly teaching tools. Such new technologies should play a significant role in the development of the caregiver profession.

Self-advocacy unit (2) focused on the necessity for the beneficiaries of professional caregivers to advocate on their own, in order to achieve a respectful level of life quality, in accordance with the fundamental human rights and also with the rights of people with disabilities, which are clearly stated in the UN Convention. It was also clearly defined that the combination of new technologies and self-advocacy may lead to a more sustainable model of caregiving.

The training material that focuses on the development of social networks (Unit 3) adds specific practical knowledge to the existing theoretical one. The development of such networks is a very important prerequisite for the creation of a fully adapted and inclusive social environment for the beneficiaries.

Finally, the social integration of the beneficiaries is a very important ingredient of their quality of life and the development of their social skills plays a significant role in the process. In Unit 4, the professionals have the chance to come across therapeutic role-playing, whose combined usage with assistive technologies and self-advocacy will contribute to the promotion of the autonomy and integration of the beneficiaries in the areas of social inclusion and personal independence.

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Unit 1

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Unit 3

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Aggregate Suggested Bibliography and Other Resources’ List

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Unit 2

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Unit 4

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Appendix A: Answers to Self-Assessment Questions

Unit 1: New Technologies

Question 1 – Correct Answer: a
Question 2 – Correct Answer: c
Question 3 – Correct Answer: b
Question 4 – Correct Answer: e
Question 5 – Correct Answer: d
Question 6 – Correct Answer: e
Question 7 – Correct Answer: b
Question 8 – Correct Answer: e
Question 9 – Correct Answer: c
Question 10 – Correct Answer: d
Question 11 – Correct Answer: e
Question 12 – Correct Answer: e
Question 13 – Correct Answer: a
Question 14 – Correct Answer: d
Question 15 – Correct Answer: b
Question 16 – Correct Answer: c
Question 17 – Correct Answer: b
Question 18 – Correct Answer: e

Unit 2: Self-Advocacy and Technology Acceptance

Question 1 – Correct Answer: b
Question 2 – Correct Answer: d
Question 3 – Correct Answer: c
Question 4 – Correct Answer: e
Question 5 – Correct Answer: e

Unit 3: Social Networks' Development

Question 1 – Correct Answer: a
Question 2 – Correct Answer: e
Question 3 – Correct Answer: b
Question 4 – Correct Answer: c

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Question 5 – Correct Answer: e

Unit 4. Therapeutic Role-Playing

Question 1 – Correct Answer: e
Question 2 – Correct Answer: e
Question 3 – Correct Answer: a
Question 4 – Correct Answer: d
Question 5 – Correct Answer: c

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Appendix B: Activities' Guide

Unit 1: New Technologies

Solution/Way of Implementation for Activity 1 – ICF

ICF:

- Describe the effect of environmental and personal factors on activities and participation.

Environmental and personal factors can have a positive or negative impact on a person's situation. Environmental factors can be, for example, technologies or services that help people overcome limitations, but also systems or relationships that prevent people from realising their potential. The same applies to personal factors (personal characteristics and attitudes, age, gender...), which can have a limiting or supporting effect.

- Find another example in which external factors can contribute to diminish a persons' disability by reducing activity limitations and participation restrictions.

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An accessible working space can enable people with a wheelchair to do a job in a company, to earn their own money and to follow the career path they wish to follow.

Solution/Way of Implementation for Activity 2 – Web Content Accessibility Guidelines

Web Content Accessibility Guidelines:

- Visit WCAG (https://www.w3.org/WAI/WCAG21/quickref/) or find a translation of them in your language and identify three guidelines that will help people with a visual impairment.

Examples:

1. *G148: Not specifying background color, not specifying text color, and not using technology features that change those defaults.*
2. *G174: Providing a control with a sufficient contrast ratio that allows users to switch to a presentation that uses sufficient contrast.*
3. *SL13: Providing A Style Switcher To Switch To High Contrast.*
4. *G14: Ensuring that information conveyed by color differences is also available in text.*
5. *G205: Including a text cue for colored form control labels.*
6. *G182: Ensuring that additional visual cues are available when text color differences are used to convey information.*
7. *G183: Using a contrast ratio of 3:1 with surrounding text and providing additional visual cues on focus for links or controls where color alone is used to identify them.*

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- Use the free online tool WAVE (https://wave.webaim.org/) to check a website of your choice for accessibility.

Enter the address of the web page you want to check in the box at the top of the page. You will then see a summary of the errors and alerts on the left-hand side as well as the specifications marked in the webpage.

Solution/Way of Implementation for Activity 3 – Application of MEESTAR

Application of MEESTAR:

- Discuss the ethical dimensions (seven ethical values and three perspectives) of MEESTAR for a specific assistive product (e.g., a smart or robotic device).
- Are there additional aspects to be considered?
- Discuss to what extend this influences the life of your clients and the work you do.

You can create a table with the seven values (and add more, if necessary), evaluate each value according to the three perspectives (individual level, organisational level, social level) and assign it to stage I to IV.

Summarise the results and show the impact of introducing the device on your clients and your work.

Solution/Way of Implementation for Activity 4 – VR and AR

VR and AR:

Answer Key:

Advantages

1. *There is scientific evidence of the effectiveness of these technologies across areas (e.g., social communication, functional living skills)*
2. *Multiple learning opportunities can be provided.*
3. *The learning environment or supports can be tailored to the individual.*
4. *Generalisations to other situations and real-world contexts is supported.*
5. *Often these technologies are motivating to engage and learn with.*
6. *It is possible to use different teaching strategies to complement technology (instructions, praise, gamifying).*
7. *It can provide a safe environment to practise skills without adverse outcomes.*

Considerations

1. *Cost*
2. *Training for staff*
3. *Space/Set up*
4. *Safety and prevention of cybersickness*

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5. *Comfort and sensitivities*
6. *Prerequisite skills*
7. *Hygiene*

Solution/Way of Implementation for Activity 5 – Brain-Computer Interface

Brain-Computer Interface:

- Describe a potential user of a P300-based BCI for communication and control: which are, in your opinion, the main factors to take into account?

Describe the motor characteristics of the potential user: would you involve also users with no residual movement? Usually, potential user is considered to be a person who is not able to access other AT (e.g., no limbs' movements, no eye movement control); however, a person with residual movements could also use BCI complementary or as an alternative to other AT (complementary in the case of a hybrid approach). Please reflect on it.

The sensory characteristics of the user should be considered: in case of a visual stimulation for the P300-based BCI, the visual condition should be considered.

Please reflect on the cognitive characteristics of the potential user: capability to understand the task, attention processes, etc.

As for all the AT, the environmental support to the user should be considered: support of the caregiver, training to the caregiver etc.

- Try to compare Brain-Computer Interface to other high-tech assistive technologies, what are the main BCI's strengths and weaknesses?

Consider the motor capabilities needed to use a high-tech AT: to control the head tracker the user needs a good control of the head; to control an eye tracker the user needs a good control of the eye. No motor control is needed to control BCI (is this a strength?).

A possible weakness could be the long time needed to set up and calibrate the device, the need for a training for the caregivers.

Unit 2: Self-Advocacy and Technology Acceptance

Activity 1 – Agreement

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Agreement:

You (the trainer and the group) can decide that it is important to establish a rule which says that you must talk in turn. So, you can say, "You can all express your ideas or feelings" or "You have the right to express your ideas and feelings" (right), "… but you must speak one at a time" or "… but you must speak in a polite manner" (duty).

Depending on the context, the trainer can decide to limit significantly his/her interventions, giving the participants the opportunity to try and even fail to set their own rules. For example, s/he may decide not to introduce the rule for speaking one at a time and let the participants understand or explain to him/her at a later stage why they find it difficult to talk if they do it all together.

Generally, try to limit your intervention but guide or assist the group when necessary, principally to ensure the involvement of each member of the group in building the agreement. You can write or ask a participant to write the rules proposed by the group and then stimulate debate about these rules in order to come to an agreement, i.e., to be sure that everyone has understood the rules and accepts them.

This kind of activity can and has to be repeated various times, changing the rules or debating about changes, when the group or a member wants it, and also expanding the areas covered by these rules.

For example, you can have an agreement on things never been managed before, such as planning a meeting or a party, for which the members of the group have to decide who is going to do what.

This scenario can be also pushed to mimicking the policy making process, introducing the idea of offices (a particular form of duty and, of course, respective rights or, better, powers).

This kind of activity is very important for various reasons:

- *It introduces the concept of rules and so those of rights and duties, too. Often, your trainee(s) already has/have some level of awareness of themselves but it is possible, especially in some contexts, that, given the wrong way in which intellectual disabilities are seen by general population, they have no idea of the correlation between right and duty, or no idea of their rights and more often of their duties, as unfortunately a lot of people tend to think that people with intellectual disabilities are only passive subjects that have to do nothing except for being cared, helped and so on.*
- *It introduces rules that are necessary for implementing group activities and working together. Moreover, if conflict of any kind arises, the agreement can be used to resolve the conflict.*
- *When the agreement-making process involves all the members of the group, it gives them a sense of belonging and ownership of the group, and can be used to introduce a set of important skills such as negotiation, assertiveness, active listening and others, linked to the field of communication.*
- *The debate to come to the agreement is a model of decision-making process that can be further explored on an individual basis, too.*

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- *When the scenario involves the creation of offices and thus puts someone in charge of something, it helps introduce the concepts of leadership and responsibility.*

Careful observation of each phase of the activity can contribute to better assess each member's potential and attitude, in addition to assessments previously performed by specialists or in addition to information previously received on the person's conditions.

Activity 2 – Strengths and Weaknesses

Strengths and Weaknesses:

Through this basic exercise, each member of the group would tell something about him/herself to the others and have a first taste of what talking in public means.

The fact that they are not introducing themselves directly to the group but to a single person can help them approach the matter and reduces possible anxiety deriving from the task. Also, when they are called to speak to the group, they are not talking about themselves, which could also be a stressing factor.

Another obvious advantage of this first step is that it helps socialisation, starting from a smaller group (the pair) to reach a wider one (the self-advocacy group), and highlights the importance of listening and not only of speaking.

Regular practice of speaking within the group help to become increasingly confident in speaking to people, thus gradually approaching the goal of speaking in public.

Forms of debate have to be encouraged during the group meetings, starting from simple topics – such preferred dishes – with the main goal of practicing speaking and then proposing or stimulating the participants to propose more relevant topics in order both to continue practicing the art of speech and to talk about matters that are important to them as persons and as a group.

Following the improvement that this kind of exercises can bring, the trainer should even propose that the participants record or film themselves in order to review their conversation and reflect on their performance.

Video records can help introduce a new element to the pattern of communication skills that the participants are learning and practicing and they probably are not aware of, that is, body language or nonverbal communication.

Coming back to strengths and weaknesses, they have to be carefully analysed by both the person and the trainer, even within the group, if possible.

The comparison with peer and an embryonic form of peer counselling possibly resulting from a group analysis can be really profitable as, often, people with intellectual disabilities can take into greater consideration the observations and advice coming from a peer rather than the opinions of their trainer.

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On the other hand, this activity boosts also the self-esteem of a person with intellectual disabilities, whose views are taken into account.

Nevertheless, the discussions conducted should be monitored in order to avoid negative results (possible bullying, false advice and so on).

Unit 3. Social Networks' Development

Solution/Way of Implementation for Activity 1 – Discussion No 1

Discussion 1:

- How to assist PWD to understand the benefits of E-social networks?

Subtopics for discussion:

- Is in-person verbal communication better compared to other forms of communication, such as written communication, signing, and online communication?

Hearing impaired people may find in-person verbal communication more difficult and would find it easier to communicate through text on a social platform.

People who have difficulty in speaking or are unable to speak cannot communicate in this way because of their physical condition; the same applies to people who have difficulties with speech or the processing of verbal communication due to conditions like mutism or as part of a condition like autism. Social media can allow them to have conversation in a format that is accessible to them, with a wide range of people that they literally would not have access to or would struggle to have access to in person.

Autistic people and people with mental health problems such as anxiety find that social media can help them access social opportunities. This is because, by participating in an online chat or group or by talking to individuals via a social platform, they feel they have a bit more control over minimising the potential problems. For example, they are able to get out of the situation much quicker than they would be able to in real life just by closing the application or by explaining that they need to go, which is considerably more socially acceptable online.

Knowing people with the same disability can be extremely useful, because you can share experiences and help each other out with disability-related challenges. Some disabled people look specifically for a disabled person when seeking a romantic partner.

Solution/Way of Implementation for Activity 2 – Discussion No 2

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Discussion No 2:

- How to assist PWD to find relevant E-social networks?

Use the design thinking method, which could help in situations such as the following:

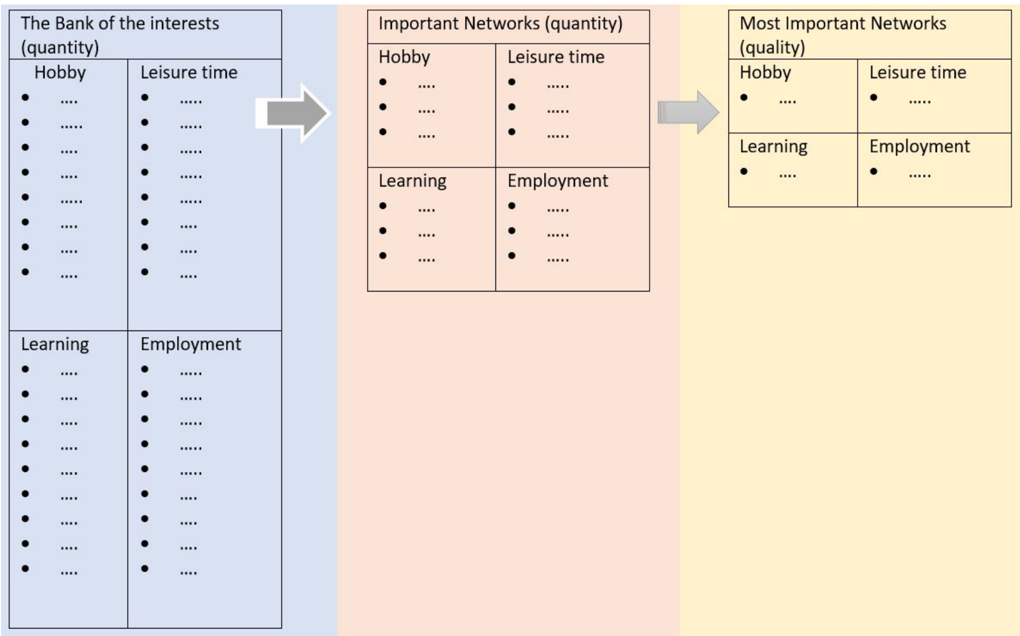
- *Mike has moved to another city and wants to find someone to accompany him when taking his dog out for a walk. He feels bad not knowing the new city.*
- *Karl has heard in the news about new space discoveries methods. He is very interested in becoming part of such a team.*
- *Monika wants to gather a group of active peers and fight together for a more sustainable environment.*
- *Lora wants to find activities for movie lovers to attend in the weekends.*

Solution/Way of Implementation for Activity 3 – Practical Exercise

Practical Exercise:

Create a visually clear map for your service users about the quality and quantity of information. See example of map below.

It is very important for a person with a disability (especially a person with an intellectual disability) to be shown very clearly how to select the most important, relevant and meaningful social networks. Also, it is important to learn how to focus on quality and not on quantity.



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Solution/Way of Implementation for Activity 1 – Role-Playing

Role-Playing:

- Discuss possible role-playing scenarios with the use of Augmented Reality in your organisation.

A role-playing scenario could be used as an effective training tool focused on social greetings as regards persons with ASD. This tool encourages social activities based on imagination and promotes the direct interaction between persons with ASD and physical role props which occur in several natural circumstances. The AR system aims to promote persons with ASD' s expression of what they understand and feel in an alternative way. Social story strategy could educate persons with ASD on basic daily life skills (getting dressed, cleaning their rooms) and in life situations at home or in the community.

- How do you believe that it would affect your clients and beneficiaries?

- *It promotes independence*
- *It instructs self- advocacy*
- *It boosts empathy*

Solution/Way of Implementation for Activity 2 – Virtual Reality

Virtual Reality:

- Create a life story scenario involving the transition of a PWD from their current routines to the appropriate behavioural norms on their own Supported Living Flat using Virtual Reality.
  - Describe the necessary steps of the following scenario: "After bathroom appropriate behaviour".
    - *An avatar demonstrates the acceptable steps:*
      - ✓ *Use the shower towel*
      - ✓ *Wear the bathrobe*
      - ✓ *Wear my underwear*
      - ✓ *Wear my clothes*
      - ✓ *Join the other flat mates*

The right order of the afore-mentioned steps is considered necessary irrespective of the person's current routine.

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Solution/Way of Implementation for Activity 3 – Ethics

Ethics:

- Discuss the advantages and disadvantages of VR & AR regarding PWD:
    - What we gain and what we should be aware of?

      + *Promote the development of everyday life skills.*
      + *Possess beneficial therapeutic outcomes.*
      + *VLE (Virtual Learning Environments) are characterised by flexibility, simplicity, low physical effort and tolerance to error.*

      - *Possible dominance of virtual world towards the real (social inclusion or exclusion)*
      - *Privacy and data protection: impact of specific characteristics (such as age)*

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