Co-funded by the Erasmus+ Programme of the European Union

RightToConnect
Digital inclusion for persons with intellectual disabilities

Literature Review

The challenges of digital literacy and social media usage of persons with intellectual disabilities

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Guidelines for using this report

This report has been formatted in way that allows users with multiply different interests to use it. Besides *Abbreviations* section and an analytic *Table of Contents*, a *List of Figures* and a *List of* Tables with hyperlinks in the report has been included, so that the reader can more easily find what they are looking for.

A user who is only interested in reading the conclusions of each research question, can easily find those at the end of every question contents. These are emphasized with bold at the end of every question contents in the *Table of Contents*. In addition, an important figure in this report (*Figure 3 Basic elements of Educational Testing Service framework*) has been emphasized with bold in the *List of Figures*. Furthermore, a very crucial table (*Table 15 Barriers and challenges when persons with intellectual disabilities use ICT*) has also been emphasized with bold in the *List of Tables*, and with dim background colour within the report. Lastly, *Annex B* is a fundamental section of this report. Nevertheless, due to its extent, it is located at the end of the report, as an annex.

The consortium would like to think that all readers will be able to find this report useful for their interests regarding persons with intellectual disabilities, ICT use, and especially the use of social media.

Abstract

Aim	State of the art knowledge in terms of challenges of digital literacy and social media usage by persons with disabilities of different ages.
Methodology	This comprehensive literature review has developed starting from the statement of various research questions that are followed by definitions, keywords, database selection, development of queries for research, specification of inclusion and exclusion criteria, search process, data extraction according to the specific exclusion and inclusion criteria, and data analysis and results of the research questions.
Results	Research questions answers.
Conclusion	Methodological framework of the project: To inform the methodology framework of the project by outlining existing practices and barriers, establish criteria for data gathering and start building a repository of data.

Abbreviations

AAC: Augmentative Alternative Communication

AAIDD: American Association on Intellectual and Developmental Disabilities

AP: Assistive Product

AR: Augmented Reality

CBR: Community Based Rehabilitation

CDC: Centers for Disease Control and Prevention

ETS: Educational Testing Service

ICT: Information and Communication Technology

ID: Intellectual Disability

IoT: Internet of Things

LR: Literature Review

NFC: Near Field Communication

NGO: Non-Governmental Organization

UDL: Universal Design for Learning

VR: Virtual Reality

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Introduction

Active participation in daily life, nowadays, requires a comprehensive understanding of digital tools that are used to make people's lives easier. As a society that has largely transitioned to a digital space, it is important to also take into account the needs and requirements of persons with disabilities, to ensure that they are not excluded.

The Erasmus+ funded project "Right To Connect Now" (RTCN) was launched to contribute to bridging the digital divide by creating accessible digital tools for persons with intellectual disabilities.

In continuation to the ENTELIS and ENTELIS+ projects, RTCN, led by EASPD, aims to achieve:

- The development of digital skills among persons with intellectual disabilities through a peer-to-peer education model.
- The development of a universally valid framework for competence development of those supporting learners with intellectual disabilities in developing their digital skills.
- The development of an accessible version of an e-learning platform for persons with intellectual disabilities that is co-designed with them, along with guidelines for its use.

The 24-month long project has 10 partners spanning across Europe that all bring to the table various expertise to achieve the goals of this project. RTCN has launched their website where any interested stakeholder can follow the progress of RCTN https://righttoconnect.entelis.net/?page_id=18

Literature review methodology

This comprehensive Literature review (LR) has developed starting from the statement of various research questions that are followed by definitions, keywords, database selection, development of queries for research, specification of inclusion and exclusion criteria, search process, data extraction according to the specific inclusion and exclusion criteria, and data analysis and results of the research questions. The intention is to provide understanding into current barriers and needs, as well as good practices, regarding persons with intellectual disabilities and digital literacy, as well as social media use.

Research questions

Table 1 that follows presents all research questions:

Table 1 *Research questions of the literature review*

Research question 1	Definition of the field (digital literacy in relation to digital competences and digital divide and) and the target group (adult persons with intellectual disabilities), identifying the areas of digital literacy based on the US Educational Testing Service report (access, manage, integrate, evaluate, create) – as highlighted in the proposal
Research question 2	Existing good practices and prospects (access, manage, integrate, evaluate, create)
Research question 3	Challenges, barriers, and accessibility issues (access, manage, integrate, evaluate, create)
Research question 4	Existing competence development for users and educators/ trainers of persons with intellectual disabilities
Research question 5	Relations of persons with intellectual disabilities and social media: an intersectional approach
Research question 6	Co-design methodology
Research question 7	Methodological framework

Keywords

A list of the keywords used in the two queries that were conducted is included in Table 2. The list is in alphabetical order.

Table 2 *Keywords used in the two queries (in alphabetical order)*

Keywords used in the two queries	
Column A	***Column B***
adult	good practices
barriers	intellectual disability
digital accessibility	internet
digital competences	internet use
digital divide	MOOCs
digital inclusion	online courses
digital literacy	online learning
educators	social media use
e-learning	teacher
adult	website

Queries

First query

Databases

Table 3 includes the databases used in the first query.

Table 3 *Databases used in the first query*

Database name	**Link**
ACM	http://dl.acm.org/
Google Scholar	https://scholar.google.com/
IEEE Xplore	http://ieeexplore.ieee.org/Xplore/home.jsp
SCOPUS	http://www.scopus.com/
Science Direct	http://www.sciencedirect.com/
Web of Science	https://webofknowledge.com/
Eric	https://eric.ed.gov/

Jstor	https://www.jstor.org/
EBSCO	https://www.ebsco.com/
Research Gate	https://www.researchgate.net/
Springer	https://link.springer.com/

Development of query for search

Table 4 depicts the individual queries conducted for the first query, the total results number, and the ones chosen by relevance of title, abstract and keywords.

Table 4 *Individual queries of the first query*

Database name	Query	Total results number	Chosen by relevance of title, abstract and keywords
ACM Digital Library	[All: (title:(] OR [[All: "intellectual disability"] AND [[All: "digital literacy"] OR [All: or] OR [All: "digital competences"] OR [All: or "barriers" or] OR [All: "digital accessibility"] OR [All: or] OR [All: "social media"]]] AND [Publication Date: (01/01/2015 TO 06/30/2022)]	18.385	46
Google Scholar	Digital Literacy and Intellectual Disability	3.090	55 (avoid duplication)
IEEE Xplore	Digital Literacy and Intellectual Disability	9	6 (avoid duplication)
SCOPUS	("Digital Literacy " OR "SOCIAL Inclusion") AND " Intellectual Disability")	263	46 (avoid duplication)
Science Direct	("Digital Literacy " OR "SOCIAL media") AND " Intellectual Disability")	463	16 (avoid duplication)

Database name	Query	Total results number	Chosen by relevance of title, abstract and keywords
Web of Science	Social Media for Intellectual Disability, Digital Literacy for Intellectual Disability, Internet for intellectual disability	7	4 (avoid duplication)
Eric	Digital Literacy for Intellectual Disability, Social Media for Intellectual Disability, Internet for intellectual disability	6.730	21 (avoid duplication)
Jstor	Same as ERIC	725	No relevant papers found
EBSCO	Same as ERIC	4.523	3 (avoid duplication)
Research Gate	Same as ERIC	100	3 (avoid duplication)

Inclusion and exclusion criteria

The following criteria were considered (also for the second query):

- Year: 2015 -2017
- Language: English
- Topic: Should be relevant to questions 1 - 6
- Age of participants in the studies: Including (but not necessarily limited to) adults of any age. Information about adolescents close to adulthood were also important for the review. Studies that included **only** children younger than 16 years of age were excluded.
- Disability:
    - Cognitive disabilities were included, unless specified that intellectual disabilities were not included.
    - Autism was included if intellectual disabilities was also a group included. It was considered important not to identify these two groups of persons with disabilities.

Search process

List of projects, research papers, guidelines, books found

Below (Table 5) follows a list of the type of publications identified in the first query.

Table 5 *Types of publications in the first query*

Types of publications	Number of publications
Projects	6
Research papers	199
Books	11
Accessibility guidelines	4
Total	221

Books

1. Assistive Technology: Principles and Practices 4th Edition, 2015
2. Assistive Technology: Principles and Practices 5th Edition, 2020
3. ICCHP, 2016 Proceedings
4. ICCHP, 2018 Proceedings
5. ICCHP, 2020 Proceedings
6. ICCHP, 2022 Proceedings
7. The role of assistive technology in fostering inclusive education: strategies and tools to support change
8. Universal Design 2021: From Special to Mainstream Solutions
9. AAATE Proceeding 2015
10. Digital Literacies
11. Education Innovation and Mental Health in Industrial Era 4.0
12. Accessibility Denied. Understanding Inaccessibility and Everyday Resistance to Inclusion for Persons with Disabilities | EBSCO Essentials

Journals

- International Journal for Research in Learning Disabilities: http://www.iarld.com/home/the-journal-thalamus
- ICLD 2022: 16. International Conference on Learning Disabilities: https://waset.org/learning-disabilities-conference-in-july-2022-in-stockholm
- British Journal of Learning Disabilities: https://onlinelibrary.wiley.com/page/journal/14683156/homepage/forauthors.html
- Association of Higher Disability and Disability https://www.ahead.org/home
- Learning Disability Journal: https://www.ahead.org/home
- Journal of Learning Disabilities: https://journals.sagepub.com/home/ldx

- Journal Of Intellectual Disability: https://onlinelibrary.wiley.com/journal/13652788
- Journal of Teaching Disability Studies : https://jtds.commons.gc.cuny.edu/

Second query

This query was conducted in EBSCO Discovery Service.

Keywords according to adjusted PICO framework (Population – Intervention – Outcome – Context)

The four groups of keywords are presented in Table 6:

Table 6 *Keywords grouped according to adjusted PICO framework*

Population	Intervention	Outcome	Context
intellectual disability	internet	barriers	social media use
adult	e-learning	digital divide	internet use
	online learning	digital literacy	website
	online courses	digital competences	
	MOOCs	digital accessibility	
	educators	digital inclusion	
	teacher	good practices	

Final research strategy with keywords

In Table 7, the final research strategy with keywords is presented, after the use of concepts with similar meaning and also truncation symbols.

Table 7 *Final research strategy in the second query*

Final research strategy with keywords		
P	01)	adult*
	02)	“intellectual* disab*”
	03)	“learning disabilit*”
04)		#01 OR #02 OR #03
I	05)	learn*
	06)	e?learning
	07)	e#learning
	08)	“on?line learning”

	09)	"on#line learning"
	10)	"on?line course*"
	11)	"on#line course*"
	12)	MOOC*
	13)	educator*
	14)	teacher*
15)		#05 OR #06 OR #07 OR #08 OR #09 OR #10 OR #11 OR #12 OR #13 OR #14
C		-
O	16)	barrier*
	17)	digital*
	18)	"digital divide"
	19)	"digita`l* *litera*"
	20)	"digital* competen*"
	21)	"digital* accessib*"
	22)	"digital* inclu*"
	23)	"good practice*"
	24)	"best practice*"
25)		#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24
C	26)	internet
	27)	"internet N3 us*"
	28)	"social media"
	29)	"social media N3 us*"
	30)	website*
31)		#26 OR #27 OR #28 OR #29 OR #30
32)		#04 AND #15 AND #25 AND #31

Query statements

In Table 8, the query statements of the second query research are presented.

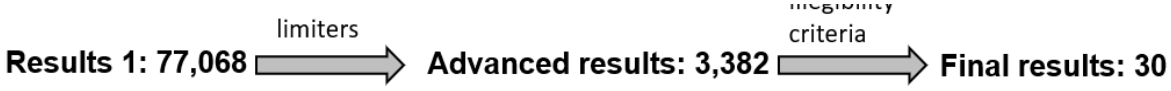
Table 8 *Query statements in the second query*

Query statements (June 18, 2022)
(adult* OR "intellectual* disab*" OR "learning disabilit*")
AND
(e?learning OR e#learning OR "on?line learning" OR "on#line learning" OR "on?line course*" OR "on#line course*" OR MOOC* OR educator* OR teacher*)
AND
(barrier* OR digital* OR "digital divide" OR "digital* *litera*" OR "digital* competen*" OR "digital* accessib*" OR "digital* inclu*" OR "good practice*" OR "best practice*")
AND
(internet OR "internet N3 us*" OR "social media" OR "social media N3 us*" OR website*)
Results 1: 77,068

Application of limiters

After extracting the first list of 77,068 results (Results 1), what followed was the procedure of limitating Results 1 with the application of limiters and then the illegibility criteria, after reading the whole publication. This procedure is presented in Figure 1.

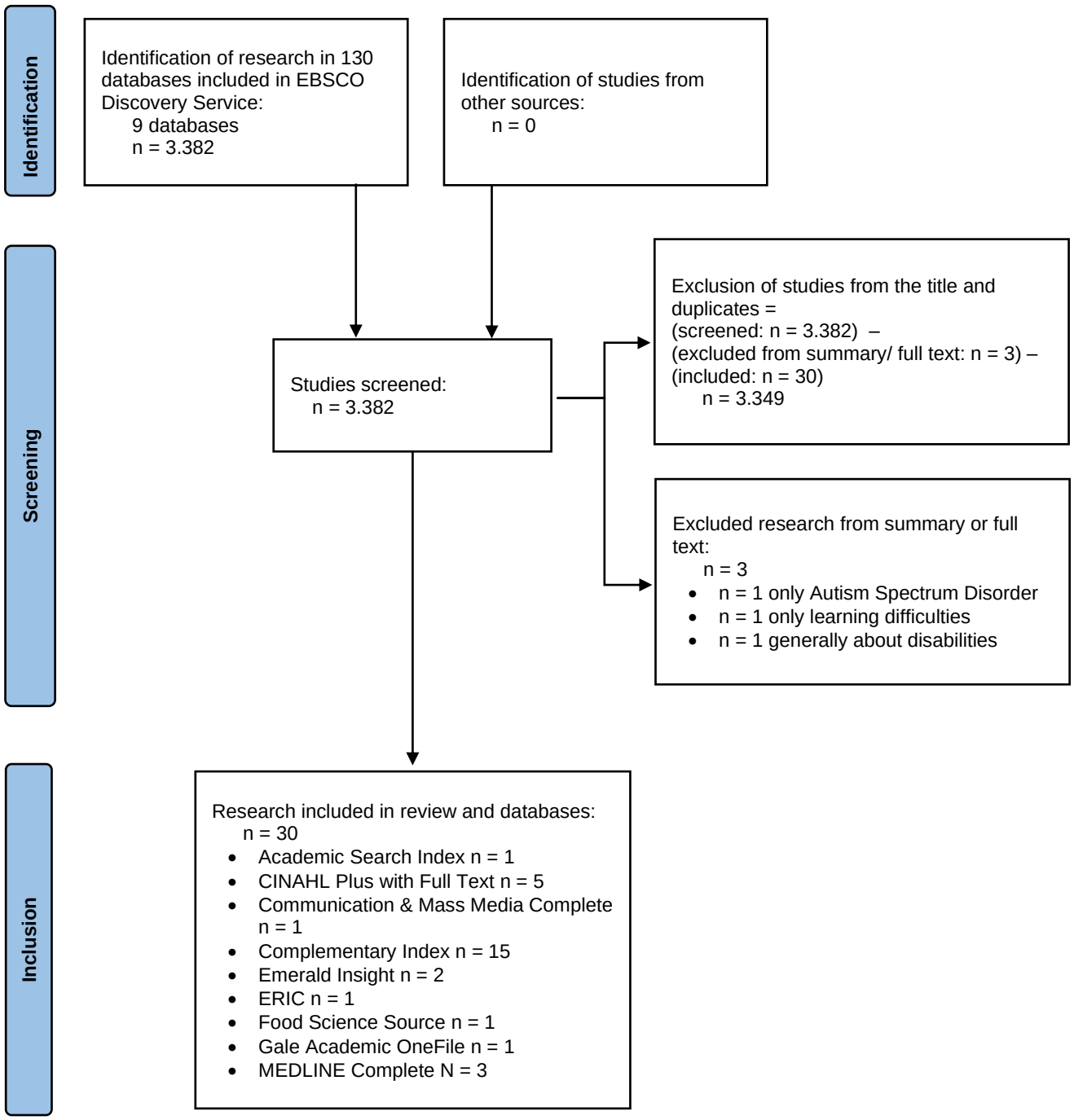
Figure 1 Limitation of Results 1 in query 2 and application of illegibility criteria



A more analytical presentation of the limiters' application is included in Annex A. It should be noted that results were reviewed up to the number 2,548 (out of 3,382), at which point the system sent the information that exact duplicates had been removed from the result. Subsequently, illegibility criteria were applied after reading the full text of some publications, and the final results included 30 publications (Figure 2).

In the PRISMA 2009 diagram that follows (Figure 2), the reader can see more information regarding the procedure that led to the selection of these 30 publications.

Figure 2 *PRISMA 2009 diagram for query 2*



Data analysis/ results of research questions

In Annex B, the reader can find a table with all publications being mapped according to Areas of Digital Literacy, based on the US Educational Testing Service Report 2020 (access, manage, integrate, evaluate, create). For the convenience of the reader, publications are in alphabetical order. This table is a central section of the review, but, due to its extent, it has been placed at the end of the document, as an annex.

Research question 1 and results: Definition of the field

Definition of the field: a. Areas of Digital Literacy (based on the US Educational Testing Service Report 2020 – access, manage, integrate, evaluate, create) in relation to Digital Divide and Digital Competences, and b. Definition of the target group (persons with intellectual disabilities).

Research question 1a and results – Definition of the field: Digital literacy, digital competences, digital divide

Background regarding digital literacy

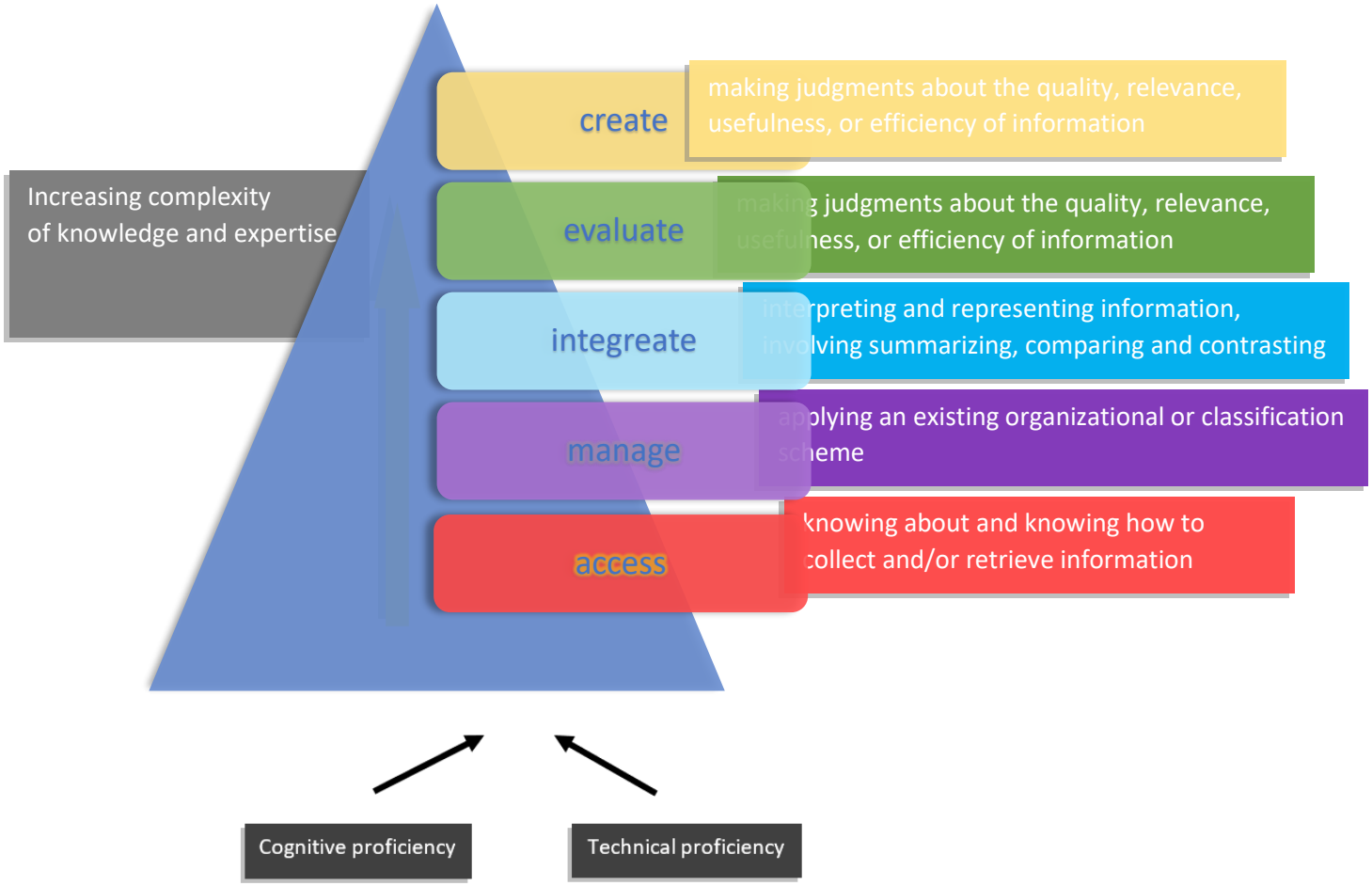
As Cihak et al. (2015) cite, the concept of digital literacy was first introduced in 1997, described as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p.1). Many variations in the definition of digital literacy have since emerged, with job-specific applications ranging from the technical aspects of operating in digital environments to the cognitive and socio-emotional aspects of a computer-driven environment (Eshet, 2004). The educational literature uses the term "21st century literacy" to describe these phenomena, applying to "the ability to read and interpret media (text, sound, images), to reproduce data and images through digital manipulation, and to evaluate and apply new knowledge gained from digital environments" (Jones-Kavalier & Flannigan, 2006, p. 9). According to Collier (2007) the integration of current technologies used today with the prerequisite skills potentially required for the use of future technology, will endow students with the skills needed to participate successfully in tomorrow's classroom and workplace (Collier, 2007). In addition, the shift from a print-based to a screen-based society calls for teachers to integrate digital literacy skills into their instruction modes, in order to prepare students for the expectations of future employers. Therefore, digital literacy is considered to be an essential life skill (Bawden, 2008).

Background regarding digital competences

New technologies are acquiring growing importance and are becoming ubiquitous in education, work, and everyday life. This constant evolution, as well as the need to include in the definition of digital literacy content that incorporated more than technical skills (as mentioned previously) led the

Educational Testing Service (2002) to define ICT literacy as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (ETS, 2020, p. 3). This definition reflects the notion of ICT literacy as a continuum, which allows the measurement of various aspects of literacy, from daily living skills to the transformative benefits of ICT proficiency. This definition incorporates five critical components that represent a set of skills and knowledge and are presented in a sequence that suggests increasing cognitive complexity. These components are presented in Figure 4 (adjusted from Educational Testing Service, 2002, p. 18).

Figure 3 *Basic elements of Educational Testing Service framework (adjusted from Educational Testing Service, 2002, p. 18).*



According to FUNKA (2022), persons with intellectual disabilities have cognitive impairments. The mental functions refer to functions of the brain that we use, for example, for cognitive processes such as taking in and processing information. Examples of mental functions are:

- Memory

- Language functions related to for example reading and writing
- Attention-related functions such as keeping focus
- Functions used in social interactions
- Functions related to emotional response in different situations

The design patterns contained in COGA Guidelines (World Wide Web Consortium, 2021) are organized into the following objectives:

- Help users understand what things are and how to use them:

  Users with cognitive and learning disabilities may have trouble with orientation and learning. This can mean people get disoriented in a site:

  - Make the purpose of your page clear
  - Use a familiar hierarchy and design
  - Use a consistent visual design
  - Make each step clear
  - Clearly identify controls and their use
  - Make the relationship clear between controls and the content they affect
  - Use icons that help the user
- Help users find what they need:

  Users with cognitive and learning disabilities may have trouble finding the content they need. They may also struggle to orient themselves inside the content or task. Users should be able to quickly and easily locate what they are looking for.

  - Make anything related to safety or that the user needs to know easy to identify without reading a lot of text
  - Provide a clear site structure and hierarchy will help users navigate to the page they need.
  - Make the most important things easy to find in the site and on each page.
  - Use good visual cues (like icons) with clear headings, boundaries, and regions to help users understand the page design. This makes the page navigation easier.
  - Provide a search facility or breadcrumbs to help users find things on the site.
  - Break media into chunks to allow users to easily find sections.
- Use clear and understandable content:

  Some users have impaired language skills. More of these users understand content which uses easy to understand language, and complex language with uncommon words may be inaccessible to them.

- Use easy to understand words
- Use short sentences
- Use simple tense
- Use short blocks of text
- Use unambiguous content
- Use clear images
- Use easy to understand videos

- Help users avoid mistakes and know how to correct them:

  Users with cognitive and learning disabilities are more likely to make mistakes. This can include entering information incorrectly or accidently touching the wrong control. Help the user notice form errors and make it easy to correct them. Always let users go back and recover if they accidentally touch a control.

  - Ensure controls and content do not move unexpectedly
  - Let users go back
  - Notify users of fees and charges at the start of a task
  - Design gorms to prevent mistakes
  - Make it easy to undo form errors
  - Use clear visible labels
  - Use clear step-by-step instructions
  - Accept different input formats
  - Avoid data loss and “Timeouts”
  - Provide feedback
  - Help the user stay safe
  - Use familiar metrics and units

- Help users focus:

  Distractions can prevent users with cognitive and learning disabilities from completing their tasks. Once users become distracted, they may find it difficult to remember what they were doing. Then they can no longer complete their task.

  - Limit interruptions
  - Make short critical paths
  - Avoid too much content
  - Provide information so a user can complete and prepare for a task

- Ensure processes do not rely on memory:

  Memory barriers stop many users from using products or accessing help or content. People with any impairment that affects memory or language can find it difficult or impossible to overcome memory barriers.

  - Provide a login that does not rely on memory or other cognitive skills
  - Allow the user a simple, single step, login
  - Provide a login alternative with less words
  - Let users avoid navigating voice menus
  - Do not rely on users' calculations or memorizing information

- Provide help and support:

  Support different ways of understanding content, explain choices to help the user successfully complete their tasks.

  - Provide human help
  - Provide alternative content for complex information and tasks
  - Clearly state the results and disadvantages of actions, options, and selections
  - Provide help for forms and non-standard controls
  - Make it easy to find help and give feedback
  - Provide help with directions
  - Provide reminders

- Support adaptation and personalization:
  - Let users control when the content moves or changes
  - Enable APIs and extensions
  - Support simplification
  - Support a personalized and familiar interface

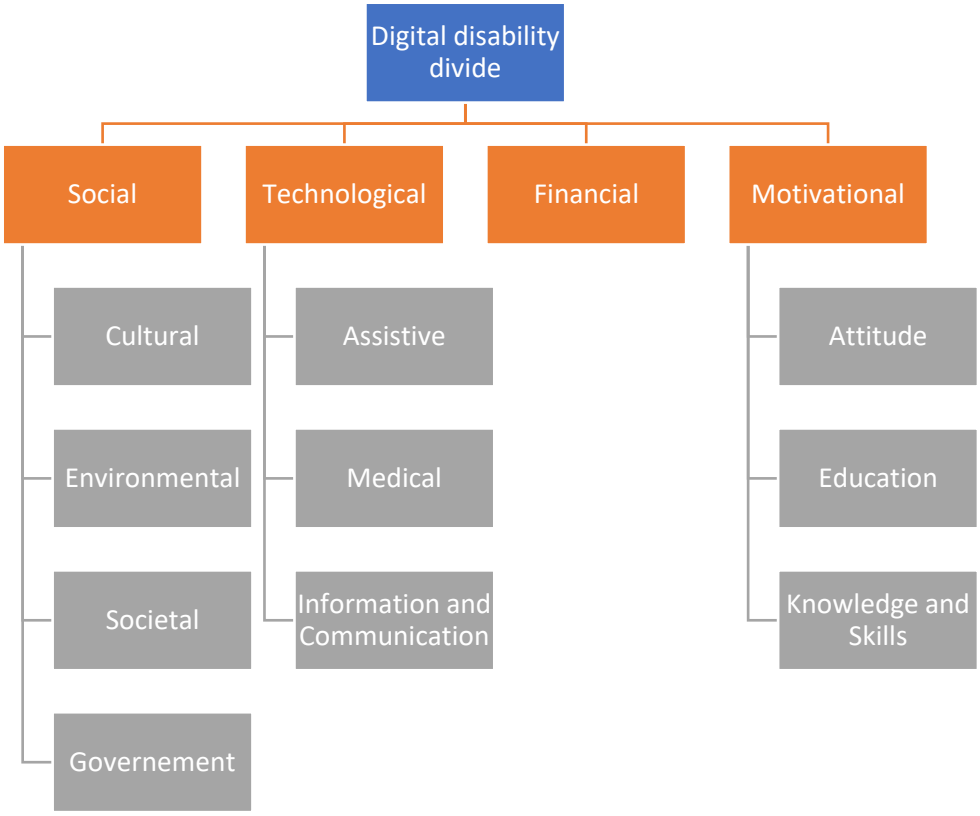
Background regarding digital divide

The advent and rapid development of technology has fundamentally changed almost every aspect of persons' lives (work, education, everyday living). This development will not stop and will result in further changes. It will also take place along the entire technology spectrum, regarding the simplest life tasks, the most complex innovations, and everything in between. The ability to adopt ICT varies substantially across countries and within communities, resulting in digital inequity. Since much of an individual's future success may rely on ICT literacy, "access to and opportunities to learn how to use

ICT must be made as equitable as possible" (Educational Testing Service, 2002, p. 5). The absence of this equity is what is being referred to as the digital divide.

Sachdeva et al. (2015) conducted a systematic literature review in order to create a framework that identifies conditions that should be considered when designing for those who are affected by the digital disability divide. This framework contains four main reasons for the digital disability divide, and these are social, technical, financial, and motivational dimensions. These are presented in Figure 6.

Figure 4 *Digital accessibility divide framework (adjusted from Sachdeva et al., 2015)*



Literature reviewed regarding 1a and results

Mapping of Educational Testing Service skills and emerging skills

In order to answer this question through the LR (and also prepare the foundation for next questions and tasks of the project) Annex B was created. Annex B maps included publications in terms of Educational Testing Service Skills (ETS). In the first column, the name of the authors is recorded in alphabetical order, and this defines the order of the presentations' order. In column *Topic*, the topic of the publication (study, theoretical, guidelines) is briefly presented, so that the reader can decide the extent to which this is interesting for them. This is relevant to the title of the publication but not identical, since titles of the publications are not always helpful enough for the reader (e.g., including

appealing questions). In column *Concepts*, important notions identified in the publications were recorded, in order to have them later grouped for our analysis (current section). In column *Stanford's Key to Information Literacy*, the corresponding verbs that are related to the publication are recorded. Finally, in column *Verbs, nouns, participles emerging*, verbs, nouns, and participles relevant to the publication and not being covered by *Stanford's Key to Information Literacy* are recorded, to define later (amongst others) the new competence framework. These findings can be found in Annex B, nevertheless, Table 9 includes the frequency of each *Stanford's Key to Information Literacy* skill (verb) regarding the literature reviewed (if one was identified and considering that these verbs represent a sequence that suggests increasing cognitive complexity).

Table 9 *Frequency of ETS different competences identified in literature reviewed*

verb in ETS	access ONLY	manage and previous	integrate and previous	evaluate and previous	create and previous
frequency	78	26	16	8	13

It is evident that most of the publications only discuss *access* ONLY issues. Much less of them discuss *manage* (26) or *integrate* (16) issues. The skill of *evaluate* is discussed in 8 publications, whereas *create* is discussed in 13 publications.

Besides the identification of ETS (Educational Testing Service) skills, some skills identified couldn't be categorized in these five skills. Verbs that seemed important and cannot be included in ETS five verbs, or are an important sub-category of them, are the following (also included in Annex B):

- navigate (which can be considered a sub-category of access and manage)
- communicate
- share versus communicate (there is a useful difference between these two)
- want: it is important to respect what the persons wants to do/achieve
- play
- support: an important action by the giver of support (also peer)
- support-ed: recipient of support (also peer)
- safety: the adequate verb could be "keep safe"

Mapping of important concepts

Concepts identified in the publications were grouped in the following categories that, as a whole, map the knowledge derived from the publications.

1. Technology types

2. Characteristics of technology
3. Related actions and situations of persons with intellectual disabilities
4. Areas and conditions of life
5. State of living
6. Carers

Technology types (1) are generic or more specific types of software and hardware, the use of which can lead to various results, through their characteristics and affordances (2). These are used by persons with intellectual disabilities (with their variety in categories recorded and described separately in 1b) by performing actions, using their characteristics, and participating in situations (3). All these are what persons need to do, to participate in areas of life that are sometimes affected by specific conditions (4). This participation is dependent to some extent on the way that persons with intellectual disabilities live (5) and of course, it is (inter)dependent on supporters (6) who might have different stances regarding technology use by persons with intellectual disabilities. Items of each group are presented in Table 10.

Table 10 *Important concepts in the publications reviewed*

Important concepts in the publications					
1. Technology types	***2. Characteristics of technology***	***3. Related actions, characteristics, and situations of persons with intellectual disabilities***	***4. Areas and conditions of life***	***5. Ways of living***	***6. Supporters***
· mobile technologies	· digital accessibility	· digital skills	· transportation	· residential homes	· educators
· touch devices	· input devices	· digital skills training	· communication	· rural communities	· carers
· TUI	· searching accessibility	· training (learning)	· commun. for medical reasons		· carers education
· speech recognition	· safety	· navigation	· health		· support
· eye-tracking	· personalization	· cognition – cognitive skills	· mental health		· gatekeeping
· AAC	· software development	· emotion	· digital health		· positive risk taking
· AT	· easy-to-read	· engagement	· e-health		· fear of loneliness*
· social media	· UDL	· support	· rehabilitation		· social care
· Facebook		· peer support	· digital participation		
· YouTube		· online learning	· daily living		
· WhatsApp		· life-long learning	· education		
· Instagram		· aging	· instruction		
· Snapchat		· advocacy	· online learning		

Important concepts in the publications

1. Technology types	*2. Characteristics of technology*	*3. Related actions, characteristics, and situations of persons with intellectual disabilities*	*4. Areas and conditions of life*	*5. Ways of living*	*6. Supporters*
· Google Maps		· self-advocacy	· life-long learning		
· forum		· co-design	· MOOCs		
· serious gaming		· transition to adulthood	· music education		
· 3D gaming		· social inclusion	· vocational training		
· 3D printing		· positive risk taking	· employment		
· AR		· perpetrator	· gaming		
· VR		· positive risk taking	· physical activity		
· NFC		· perpetrator	· leisure		
· digital services			· COVID-19 reality		

**Parents being afraid that their child is and will be feeling lonely*

Conclusions

Digital literacy is a very important concept, with a number of variations that should be considered. Besides technical proficiency, cognitive proficiency is also fundamental for unconstrained use. Educational Testing Service of the U.S. (2002) has defined five critical components for their digital competence framework (Figure 4). The cognitive impairments that persons with intellectual disabilities present make the use of digital technologies more difficult for them, thus, digital technologies should be adjusted to also meet their needs. The design patterns contained in COGA Guidelines are organized into the following objectives:

- Help users understand what things are and how to use them
- Help users find what they need
- Use clear and understandable content
- Help users avoid mistakes and know how to correct them:
- Help users focus
- Ensure processes do not rely on memory
- Provide help and support
- Support adaptation and personalization

People with disabilities (including those with intellectual disabilities) have less access to and opportunities to learn how to use ICT, and this constitutes a digital divide, which is social, technological, financial, and motivational. Analysis of the publications identified in this literature review led to the conclusion that most of them discuss access issues and leave aside (to a great extend) manage, integrate, evaluate, create components. Analysis of the publications also identified other important verbs, that should be included in the competence framework for persons with intellectual disabilities. These are: navigate (which can be considered a sub-category of access and manage), communicate, share, support (more specifically: ask for support, receive support), play, keep safe. Lastly, the analysis of the literature, led to seven important areas of concepts, that were important for the identification of important parameters for the answers of subsequent questions. These were: technology types, characteristics of technology, related actions, and situations of persons with intellectual disabilities, areas and conditions of life, state of living, and carers.

Keeping in mind the conclusions from question 1a, 1b will be answered, concerning the definition of intellectual disabilities, and of course, important relevant statistic derived from the publications studied.

Research question 1b and results – Definition of the field: Intellectual disabilities

Definitions and categories

Intellectual disability

Intellectual disability is one of the various conditions that are collectively known as developmental disabilities (AAIDD, 2022). Developmental disabilities are a group of conditions that are caused by an impairment in physical, learning, language, or behaviour areas. These conditions begin during the developmental period, and their impact may regard day-to-day functioning. Their duration is usually a person's lifetime (CDC, 2022).

Intellectual disability, specifically, is "a condition characterized by significant limitations in both intellectual functioning and adaptive behavior that originates before the age of 22" (AAIDD, 2022, Age of onset) and it should be "confirmed by clinical evaluation and individualized standard IQ testing" (Boat & Wu, 2015). There are two important concepts related to ID:

- Intellectual functioning (also called intelligence) refers to general mental capacity, such as learning efficiently and learning from experience, reasoning, problem solving, planning, solving, abstract thinking, comprehending complex ideas, etc. IQ tests are used to measure intellectual functioning, although DSM-5 criteria point to impairment in one or more superordinate skill domains (e.g., conceptual, social, practical), having placed more emphasis on adaptive functioning and the performance of usual life skills (AAIDD, 2022; Boat & Wu, 2015).
- Adaptive behavior is "the collection of conceptual, social, and practical skills that are learned and performed by people in their everyday lives" (AAIDD, 2022, Adaptive Behavior).

Severity of intellectual disability

The terms "mild," "moderate," "severe," and "profound" ID have been widely used to describe the severity of the condition (Table 9). This approach has been helpful in that aspects of mild to moderate ID differ from severe to profound ID.

- Mild to Moderate ID:
    - Most of the persons that have intellectual disabilities are classified in this level.
    - Individuals with mild ID are slower in all areas of conceptual development and social and daily living skills. These persons can learn practical life skills, which allows them to function in daily life with minimal levels of support.
    - Individuals with moderate ID can take care of themselves, travel to familiar places in their community, and learn basic skills related to safety and health. They also require moderate support regarding their self-care.

- Individuals with mild to moderate disability are less likely to have associated medical conditions than those with severe or profound ID.

- Severe ID: Severe ID is characterized by major delays in development. These individuals often have the ability to understand speech, but sometimes they have limited communication skills (Sattler, 2002). individuals with severe ID require supervision in social settings and often need family care to live in a supervised setting such as a residential, home despite the fact that they are able to learn simple daily routines and have minimum self-care skills.
- Profound ID: The cause of profound ID often lies on a congenital syndrome (Sattler, 2002). These persons cannot live independently, requiring close supervision and support regarding self-care activities. Their ability to communicate is very limited and they often encounter serious physical limitations.

Table 11 is an adjustment of the table presented in Boat and Wu (2015) and is helpful in summarizing the various levels of ID and their distribution, DSM-IV criteria (more medically oriented, for diagnosis), DSM-5 criteria (oriented in functioning and daily living skills) and AAIDD criteria (on the basis of the support needed). It is important to note the paradigm shift, that has led to the assessment of support needed.

Table 11 *Types of ID (severity) and their distribution, according to DSM-IV, DSM-5 and AAIDD criteria (adjusted from Boat & Wu, 2015)*

Severity category	Approximate percent distribution of cases by severity	DSM-IV criteria (severity levels were based only on IQ categories)	DSM-5 criteria (severity classified on the basis of daily living skills)	AAIDD criteria (severity classified on the basis of intensity of support needed)
Mild	85%	Approximate IQ range 50-69	Can live independently with minimum levels of support	Intermittent support needed during
Moderate	10%	Approximate IQ range 36-49	Independent living may be achieved with moderate levels of support, such	Limited support needed transitions of periods of uncertainty in daily situations

Severity category	Approximate percent distribution of cases by severity	DSM-IV criteria (severity levels were based only on IQ categories)	DSM-5 criteria (severity classified on the basis of daily living skills)	AAIDD criteria (severity classified on the basis of intensity of support needed)
			as those available in group homes	
Severe	3,5%	Approximate IQ range 20-35	Requires daily assistance with self-care activities and safety supervision	Extensive support needed for daily activities
Profound	1,5%	IQ<20	Requires 24-hour care	Pervasive support needed for every aspect of daily routines

Cause of intellectual disability

Many cases of ID in the population are of unknown cause. Nevertheless, a great number of factors that can be the cause of ID has been recognized and follows in categories (Gustafsson, 2003, as cited in Boat & Wu, 2015):

- Environmental factors
  - exposure to toxic substances during prenatal period
  - maternal infections (e.g., rubella, cytomegalovirus)
  - nutritional deficiencies (e.g., prenatal iodine deficiency)
  - brain radiation
  - childhood brain infections
  - traumatic brain injury
  - prenatal and postnatal complications may cause brain injury resulting in ID
- Genetic factors: these play a major role in ID, with different genetic causes leading to ID
  - Down syndrome (trisomy 21) is the most common genetic cause of ID
  - fragile X syndrome is the most commonly known inherited cause of ID and mostly affects boys

Demographics of intellectual disability

Males are more likely than females to be diagnosed with ID. Overall, studies of prevalence show a male excess in the prevalence of ID, which is partially explained by x-linked causes of the disability, such as fragile X syndrome (Durkin et al., 2007, as cited in Boat & Wu, 2015).

In the United States, the prevalence of ID varies by race/ethnicity, probably due to confounding by socioeconomic status. Black non-Hispanic children are approximately twice as likely, and Hispanic children approximately one and a half times as likely, to be diagnosed with ID as white non-Hispanic children (Bhasin et al., 2006; Boyle and Lary, 1996; Boyle et al., 2011; Camp et al., 1998; Van Naarden Braun et al., 2015, as cited in Boat & Wu, 2015). It is also recorded that language differences and poverty likely contribute to the racial and ethnic differences in performance on cognitive tests and to the corresponding disparities in prevalence. Also, there is evidence that test bias and diagnostic bias affects the rates of the diagnosis of ID (Jencks and Phillips, 1998, as cited in Boat & Wu, 2015).

Socioeconomic status affecting intellectual disability

Poverty is one of the most consistent risk factors for ID (Cooper and Lackus, 1983; Durkin et al., 1998; Stein and Susser, 1963, as cited in Boat & Wu, 2015).

Comorbidities

What needs to be considered is the overlapping or co-occurring neurodevelopmental, psychiatric, and medical conditions and ID. Intellectual disability is a condition that can be manifest in a number of diagnoses, including:

- communication disorders
- Down syndrome
- cerebral palsy
- epilepsy
- ASD (autism spectrum disorder)
- various congenital conditions
- psychiatric conditions (at least 25 percent of persons with intellectual disabilities may have significant psychiatric disorders, and specifically increased rates of schizophrenia, depression, and ADHD (Bouras and Holt, 2007; Fletcher et al., 2007, as cited in Boat & Wu, 2015).

Literature reviewed regarding 1b and results

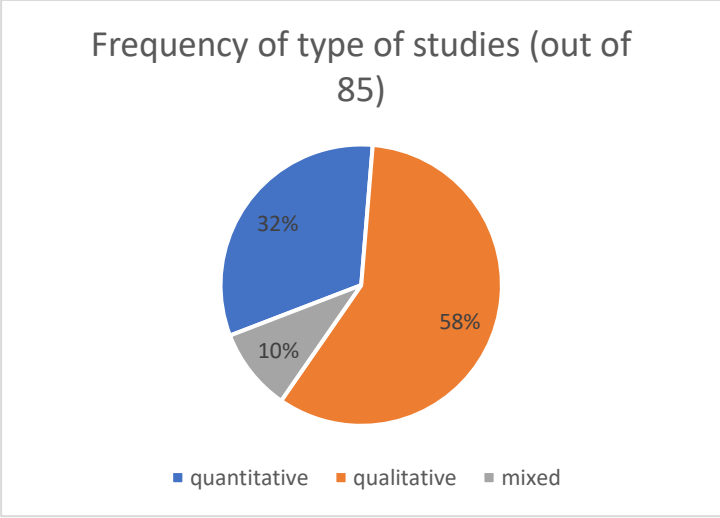
Type of studies

Out of 92 publications reviewed, 85 of them were research projects that investigated perceptions, practices, and habits of persons with intellectual disabilities and/or parents, caretakers, trainers, staff, designers, other researchers, etc., or results of digital technology usage. A control group also

including persons without ID was included in two studies: the first was related to the adaptation of the Social Network Guide (system for measuring the structural, interactional, and supportive aspects of individual's networks) according to the needs of adolescents (age 14 to 17) with and without ID (White et al., 2020). Also, Salmerón et al. (2016) investigated the way that students with ID evaluate recommendations from internet forums and compared them with students of matching ages but higher educational levels and to younger students with similar verbal and intellectual age.

As can be seen in Figure 7, out of 85 studies, 58% (n=49) 49 were qualitative, 32% (n=27) were quantitative, and 10% (n=8) were mixed. A mixed methodology was chosen by Senaratne et al. (2021), who examined the design, development, and evaluation of TronicBoards, a curated set of accessible electronic modules. The number of participants in this study was three-digit. Bonilla del Río et al. (2022), examined with a mixed methodology the way that the use of social media allows 10 persons with Down syndrome (adults or close to adulthood) to take part in the digital environment. Khan et al. (2021) investigated the way smart devices and applications help 53 young adults with Down syndrome to perform independent activities. Lastly, Song et al. (2020) examined whether technology can effectively promote the impact scaling of NGOs providing services for adolescents the use of an online open-source educational platform. The participants were 150 in total, but it is not clarified how many of the users were persons with intellectual disabilities or staff.

Figure 5 *Frequency of type of studies (out of 85)*

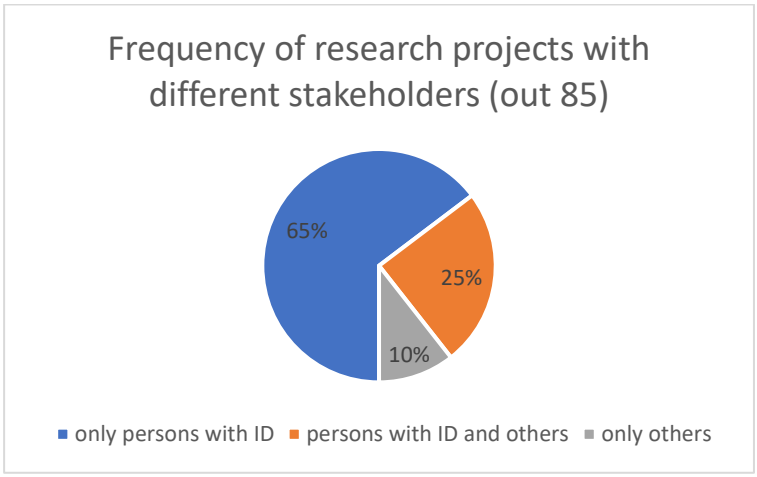


Studies with the participation of different stakeholders and number of participants

As shown in Figure 5, 65% of projects (n=55) included only persons with intellectual disabilities, 25% (n=21) included persons with intellectual disabilities and other stakeholders, and 10% (n=9) included only other stakeholders. Regarding the latter, e.g., the aim of Lussier-Desrochers et al. (2020) was the

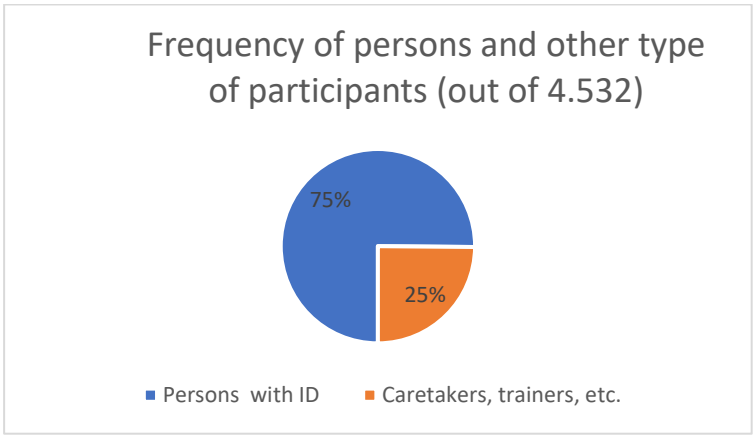
creation of a conception model with participatory attributes. That model would guide the advancement of technologies intended for the active involvement of persons with intellectual disabilities or ASD and for that purpose, they asked the opinions of three designers. Additionally, Ramsten et al. (2019) inquired staff perceptions in residential homes, with reference to the role of ICT and how ICT affects the daily life of young adults with mild to moderate ID. Nevertheless, some researchers conducted separate research, e.g., with persons with intellectual disabilities in one study and educators in another, in order to investigate an issue from different points of view, in the frame of larger research projects.

Figure 6 *Frequency of research projects with different stakeholders (out of 85)*



The total number of participants in the research projects was estimated to be 4.352. Persons with intellectual disabilities were 75% (n=3.270, *M*=38.47, *Mdn*=11), whereas caretakers, trainers etc., were 25% (n=1.082) (Figure 6).

Figure 7 *Frequency of persons and other type of participants (out of 4.532)*



Different types of stakeholders taking part in the studies have been recorded to be the ones following. Regarding stakeholders that are not often met in studies, specific examples can been given:

- Parents: included in a great number of studies that included other stakeholders
- Siblings: McDonald et al. (2022) also asked the opinion of a sibling when they worked on the identification of strategies for facilitating inclusion for of adults with ID as direct respondents in (might be online) research.
- Guardians: McDonald et al. (2022) *(*see *siblings).*
- Carers, support workers, coaches: similar terms, participating quite often in studies.
- Staff within an organization: Chiner et al. (2017) investigated caregivers' concerns, prevention strategies and training needs, regarding internet and persons with intellectual disabilities.
- Manager of an organization.
- Institutional Review board (IRB): McDonald et al. (2022)
- Mainstream service managers: Wiesel et al. (2022) investigated the adjustments (modes of practice) made to include persons with intellectual disabilities in mainstream services.
- Service providers: McDonald et al. (2022)
- Teachers: quite often interviewed.
- SEN instructors: often participating.
- College students: Jenaro et al. (2018) investigated internet and cell phone usage patterns among young adults with or without ID.
- Post-graduate students: Buehler et al. (2016) investigated accessibility barriers to online post-secondary education for young adults with ID and also included post-graduate students in their study.
- University instructors: Prohn et al. (2015) included university instructors in their research concerning studying abroad inclusively for students with and without ID.
- Designers: Lussier-Desrochers et al. (2021) worked on the creation of a participatory conception model that would guide the development of technologies intended for the active involvement of persons with intellectual disabilities or ASD, and they included designers in their research.
- Researchers: Iatraki et al. (2021) also included researchers as evaluators of an educational AR - VR system for persons with intellectual disabilities.
- Self-advocates: Frawley et al. (2015) investigated reflections on being a first-generation self-advocate, and also interviewed government officers.

- Government officers: Frawley et al. (2015) interviewed government officers regarding self-advocacy.
- Other professionals: Alanzi et al. (2022) suggested the inclusion of taxi-drivers when evaluating or designing transportation apps for persons with intellectual disabilities.
- General population: Chadwich et al. (2017) investigated the perceptions regarding the risks and benefits of internet access for persons with intellectual disabilities.

As can be seen above, McDonald et al. (2022) included a unique variety of stakeholders in their research, regarding persons with intellectual disabilities direct responding in (might be online) research.

Concerning the publications in which persons with intellectual disabilities participated, as can be seen in Figure 7, 26 studies included single-digit number of participants. One of these studies included only one person with ID, an 18-year-old student who evaluated the design of a system that could assist in the creation of digital learning environments that contribute to Science Education. This contribution was implemented through the use of augmentative and virtual reality, whereas teachers and researchers also participated in the evaluation of the system (Iatraki et al., 2021). Studies with low number of participants were usually qualitative, investigating perceptions and attempting to identify important concepts. Studies with greater number of participants were qualitative or quantitative, conducting statistical analysis of performance, etc.

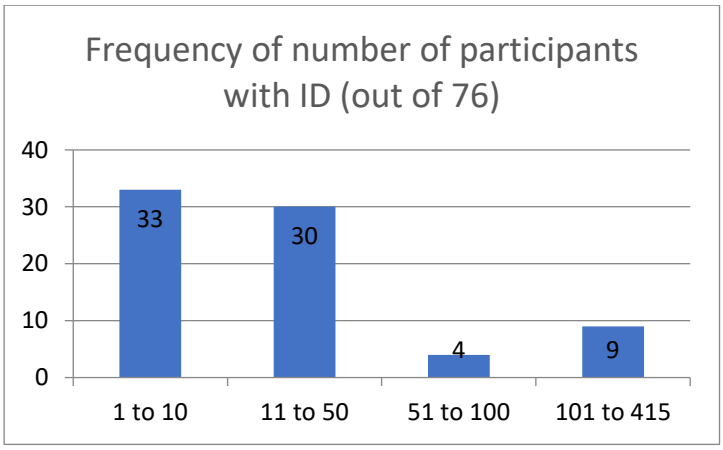
The studies that included two-digit number of participants (with ID) were 41, and the studies that included three-digit number of participants (with ID) were nine. All nine studies were quantitative or mixed. Alfredsson et al. (2020), in quantitative research, investigated the digital participation of 114 adolescents with ID (13 to 20 years old), concerning their access to internet-enabled devices, the variety of internet activities they perform, their difficulties in using the internet, and also issues of risk management regarding internet use. Martin et al. (2021), in a quantitative study, investigated the aspects of mobile devices and applications use that are associated with the social inclusion of 114 adult persons with intellectual disabilities. Senaratne et al. (2021), in a mixed study, examined the design, development and evaluation of a curated set of accessible electronic modules. The participants of this study were 158 adult persons with intellectual disabilities. In another study, that was also quantitative, Kim et al. (2021) investigated internet access of 298 adults with IDD, and also the factors that are correlated with internet usage. Lastly, in one more quantitative study, Arun et al. (2022) examined the independent use of smartphones by 415 persons with DD (minors, adolescents, and adults). Perceptions of their parents were also investigated, to find out whether they could benefit from online teaching, worksheets, and videos.

Figure 8 *Number of persons (with ID) as participants in studies*

Stem	Leaves
0	1 1 1 3 3 3 3 3 4 4 4 4 4 5 6 7 7 7 7 8 8 8 9 9 9 9
1	0 0 0 0 0 0 0 1 2 2 4 5 5 5 5 8 9
2	0 0 0 0 0 0 1 3 3 4 5 6 7 7
3	3 6
4	0 0 3
5	0 3
7	5 7
9	4
11	4 4
12	4
15	8
21	6
26	9
29	8
35	2
41	5

Also, as can be seen in Figure 8, an almost equal number of studies had from 1 to 10 participants, or 11 to 50 participants (33 and 30 studies) has been recorded. Four of the studies had 51 to 100 participants, whereas nine of them had 101 to 415 participants.

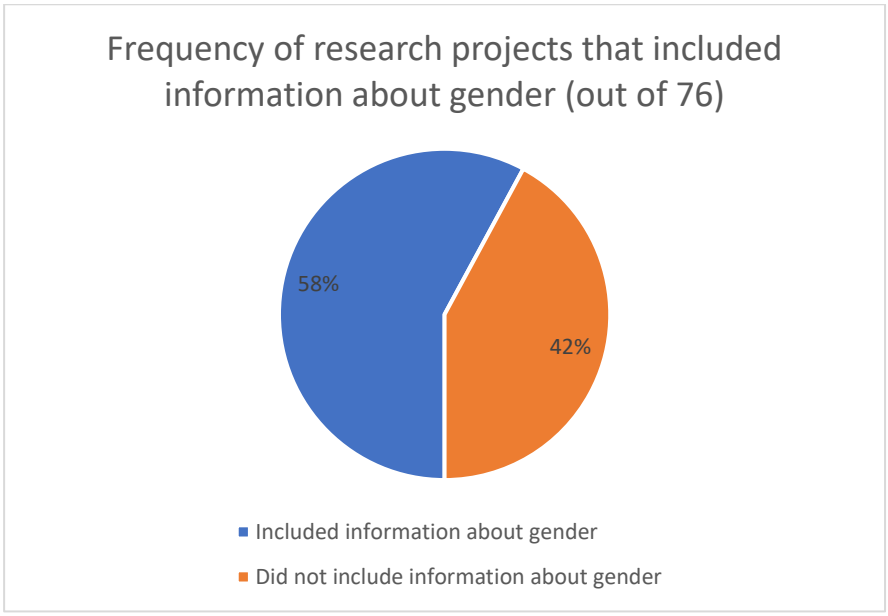
Figure 9 *Frequency of number of participants with ID (out of 76) - different grouping*



Gender information

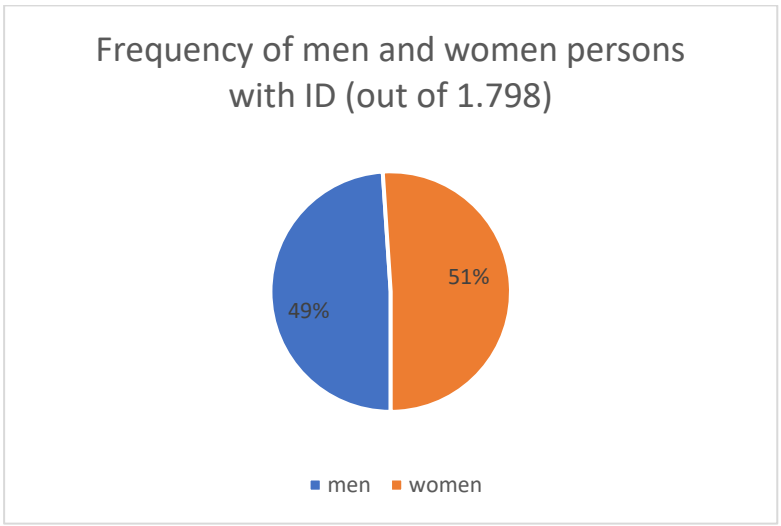
Out of 76 research projects where persons with intellectual disabilities participated, 58% (n=44) included information about the gender of the persons with intellectual disabilities, and 42% (n=32) did not include this kind of information (Figure 9).

Figure 10 *Frequency of research projects that included information about gender (out of 76)*



Out of 1.798 persons with intellectual disabilities (or control group) the gender of which has been recorded, 49% (n=880) were men and 51% (n=918) were women (Figure 10). It is interesting to note that women are slightly more than men, and that Seok et al. (2017) included in their study (digital literacy of youth and young adults with ID) a lot more women than men (233 women, 119 men). Gender data were recorded in this review regarding only persons with intellectual disabilities, and not regarding other stakeholders.

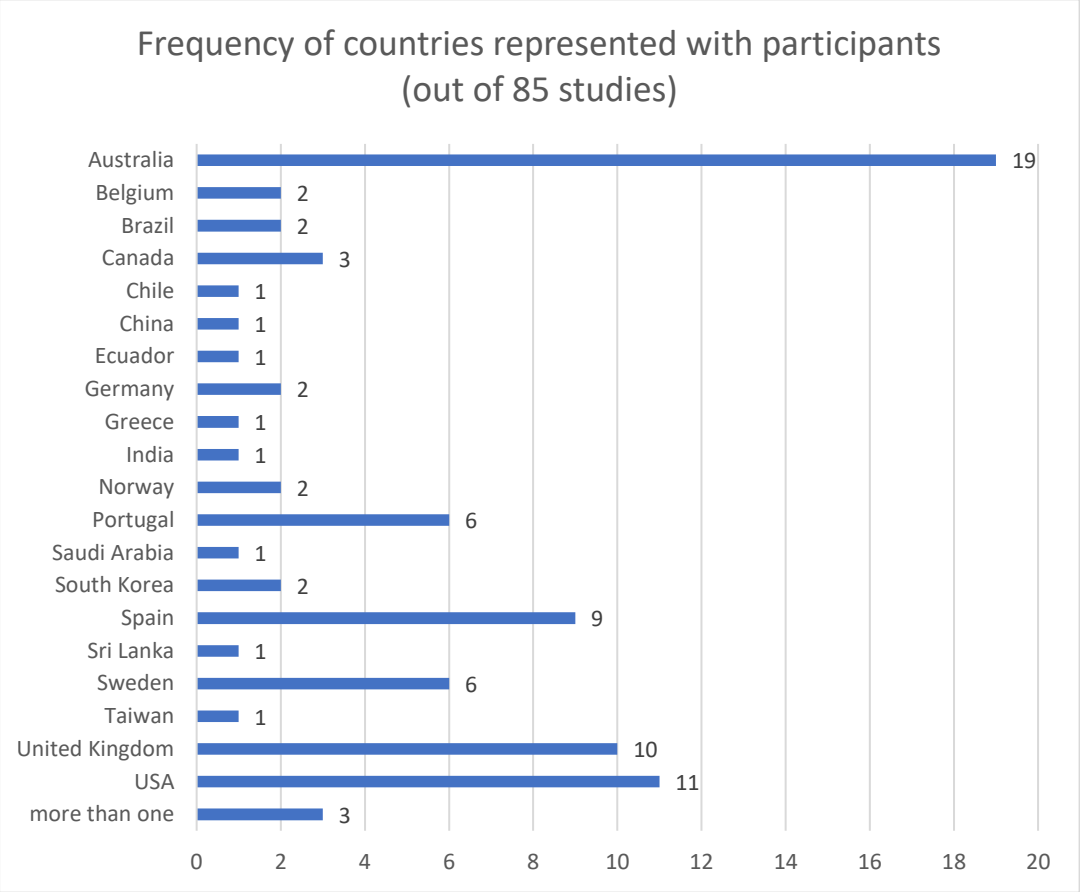
Figure 11 *Frequency of men and women persons with ID (out of 1.798)*



Country of residence

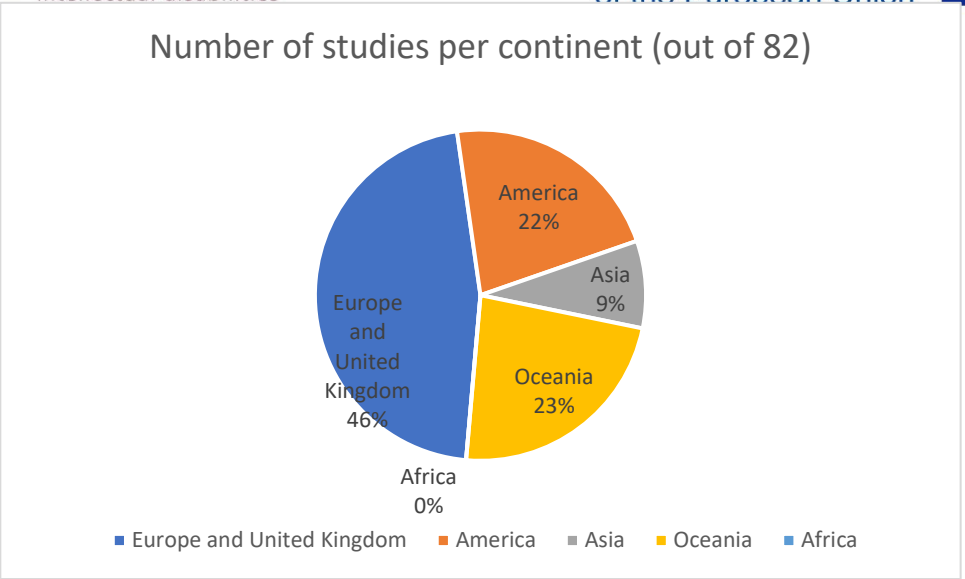
Concerning the countries where the participants with ID resided (Figure 11), Australia had most (19) studies, USA had 11, United Kingdom had ten, Spain had nine, Portugal and Sweden had six, and the rest of them had three, two, or one publication. Three studies include participants from more than one country.

Figure 12 *Frequency of countries represented with participants (out of 85 studies)*



If countries are matched to the continents, the (Figure 12), it can be seen that, out of 82 studies conducted by single countries, most of them (46%) were conducted with people from a European country or United Kingdom, 22% in America, 9% in Asia, and 23 percent in Oceania (all in Australia). It is important to note that none of the studies was conducted with people from an African country.

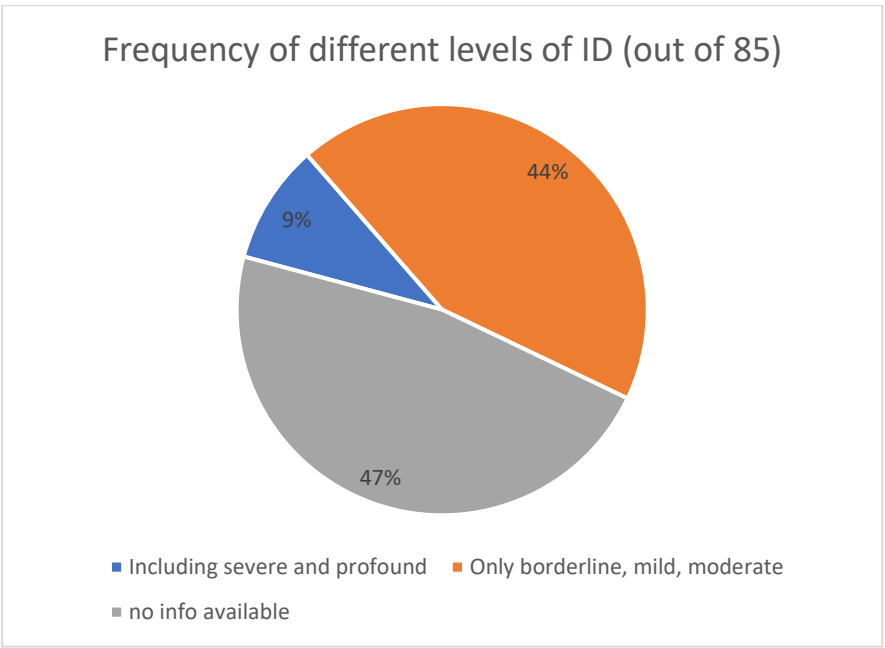
Figure 13 *Number of studies per continent (out of 82)*



Levels of intellectual disability

Concerning the frequency of different levels of ID, as it was explicitly stated in 85 research projects, only 9% of them (n=8) included participants with severe or profound ID. Participants with at least borderline, mild, or moderate ID were included in 44% (n=37) of the research projects. For 47% of them (n=40) there were no specific information available about the type of severity, although sometimes this might be assumed by the context of the study (e.g., vocational training). Nevertheless, this is not a safe decision, thus, it was not taken (Figure 13). It also is interesting to note that a number of authors consider it inappropriate to record the level of ID, since what more interests them is their needs.

Figure 14 *Frequency of different levels of ID (out of 85)*



Age of persons with intellectual disabilities

With regard to the range of age of the participants with ID, the lowest age was 6 years and the highest was 74. The lowest age (6) was included in a study regarding independent use of smart phones by individuals with developmental disabilities, to find out if they could benefit from online teaching, worksheets, and videos. The study also included persons up to 41 years old. The highest age (60 to 74) was included in a study that investigated the learning strategies, preferences, and learning settings of older adults with (and without) ID. The field was learning ICT and emphasis was given on strategies that are connected to self-regulation (Schlomann et al., 2021). Also, Wiesel & Bigby (2022) examined the adjustments (modes of practice) made to include persons with intellectual disabilities in mainstream services and included participants from 18 to 74.

Conclusions

Definition of intellectual disabilities and types of this disability can vary according to the perspective. AAIDD emphasized the importance of support needed by the person with ID, in shift of paradigm from previous medical paradigms. Many causes of ID can lead to various levels of severity affect the support that a person with ID may need, or the way that a person with ID can ask for support themselves.

In the studies included in this LR, most of them were research projects that investigated perceptions, practices, and habits of persons with intellectual disabilities and/or parents, caretakers, trainers, staff, designers, other researchers, etc., or results of digital technology usage. Almost half of them were qualitative studies (emphasizing the *why*s and *hows*), one third of them were qualitative (answering *how many* and *how much*), and one tenth of them were mixed studies.

It is important to record how many stakeholders are involved in these studies. In most of them (65%), only persons with intellectual disabilities were included). Teachers, trainers, carers, designers, etc., were other stakeholders being asked opinions. In studies where persons with intellectual disabilities and other stakeholders were included, 25% of these persons were trainers, carers, etc. Self-advocates are only seldom included in these studies.

An almost equal number of studies had from 1 to 10 participants, or 11 to 50 participants (33 and 30 studies). Four of them had 51 to 100 participants, whereas nine of them had 101 to 415 participants.

Concerning the gender of persons with intellectual disabilities participating, almost half of them didn't include relevant information. Regarding the studies that did include this kind of information, men and women were almost equally represented.

Regarding the country of residence of the participants, Australia had most of the studies. Regarding the continent of residence of the participants, almost half of them resided in Europe and United Kingdom, around 20% resided in America (North and South), another around 20% in Oceania (practically Australia) and almost 10% in Asia. It needs to be noted that none of the studies included participants from any African country.

Regarding a great number of studies (almost half of them), no specific information was available regarding the level of ID. Regarding the rest half of the studies, only borderline, mild and moderate ID were investigated in most of them, whereas severe and profound levels of ID were included in almost 5% of these studies. This may indicate the fact that, for persons with severe and profound ID, other issues still remain to be solved, before addressing their ICT and digital skills.

Concerning the age of participants with ID, the lowest age was 6 years old (but also included persons up to 41 years old). The highest age was 60 to 74 years old.

Research question 2 and results - Existing good practices and prospects

Based on the analysis of the literature reviewed in this report, a number of good practices were identified, which can lead to certain results, and refer to the following areas (Table 2):

Table 12 *Categories of good practices*

Categories of good practices
theoretical good practices
technology use - accessibility requirements ONLY
communication
social media
social inclusion enhancement
education
searching and evaluation of information
transportation
everyday living
safety in everyday life for a person with intellectual disabilities
gamification

In category *technology use - accessibility requirements ONLY*, there are publications that only refer to those, without connection to other areas. Also, it was considered important to keep the distinction between communication, social media, and social inclusion. Lastly, safety in everyday life refers to safe use of technology, specifically in a way that is related to the safety of a person with intellectual disabilities in their everyday life. It is important to note that these are the categories derived from the specific LR, and not an exhaustive list of categories.

Categories of good practices

A short analysis of each relevant publication or study is presented in the following section, grouped in the above-mentioned categories:

Theoretical good practices

Nguyen (2020) promoted the creation of a conceptual framework for key dimensions of digital inclusion in general. They identified four feature categories in the digital accessibility area: availability, connectivity, affordability, and assistive design. Concerning availability, it was defined as "opportunity and means to access specific education technology" (Nguyen, 2020, p. 9). Specifically, the availability category was used to indicate the technology genre required for the learning activity. Digital literacy was defined as "the ability to find, evaluate, utilize, and create information by using

various tools and platforms effectively and efficiently" (Nguyen, 2020, p. 9). They also distinguished computer literacy and information and media literacy. Computer literacy "focuses on the skills required for using digital devices" (Nguyen, 2020, p. 9). Information and media literacy refer to "the ability to find, evaluate, and utilize needed information and media" (Nguyen, 2020, p. 9). Digital acceptance refers to "the understanding and attitudes towards the use of digital technology" (p. 9). This dimension contains "the awareness of technology, perceived usefulness, perceived usability, and perceived trustworthiness" (Nguyen, 2020, p. 9).

Lussier-Desrochers et al. Lussier-Desrochers et al. (2020) examined the creation of a participatory conception model that could guide the development of technologies intended for the active involvement of persons with intellectual disabilities or ASD. They presented four stages concerning the research and development process: 1) the specification of the development idea, 2) the structuring of novel solutions, 3) the development and improvement of the prototype, and 4) the dissemination of the products and of the research results.

Chang et al. (2021) created a tangible design framework for practitioners to follow when designing an online social media platform for individuals with ID. The parameters they considered important and that could be applied also in other categories of applications, are the following:

- registration, credentials and authentication, skill pre-assessments
- usability, adaptive design, responsive design
- system security and testing, usability testing, system security
- education strategies, cybersecurity awareness, system training

The authors also recorded the need for the incorporation in future-alternative frameworks, of concepts such as serious gaming and digital mental health.

Technology use - accessibility requirements ONLY

The Buddy platform (Johannes Kepler University & FUNKA, 2022) assists people with cognitive disabilities to interact with digital services by using assistive technology. Making use of artificial intelligence, persons with cognitive disabilities have direct access to the most suitable tools and are able to use an online repository of digital assistive technologies. This repository is enhanced by professionals who develop and manage assistive technologies and share their products.

Easy Reading Project (Johannes Kepler University, 2020) is a software tool that enhances cognitive accessibility of web content and assists users with cognitive disabilities to access, read and understand more easily any existing webpage. It includes 1) useful terms and definitions (templates and guidelines for developing a consent form to be used in inclusive research, checklist, and online

functions that aid individuals for reading and understanding websites), 2) useful guidelines for conducting inclusive research, where academic researchers can work with persons with cognitive disabilities as co- researchers or peer-researchers, and 3) ways of developing personalized interface concepts for persons with cognitive disabilities.

FUNKA (2022) has developed and tested five criteria for cognitive accessibility, that are considered necessary for standardization and legislation. These are: 1) clickable objects, 2) interactive elements, 3) understanding of important information, 4) indication of progress, 5) users location

Morato et al. (2020) worked on the creation of the tool Comp4Text for the adaptation of documents and web pages according to the easy-to-read rules (concerning structure, spelling, typography, vocabulary, design and visual presentation of the text, and simplification). The tool would assist in the detection of readability barriers and assist text writers and editors in the process of editing and adapting original texts for fulfilling the easy-to-read guidelines, allowing them also to save time. The application also provided a visual representation of readability issues. The homepage was simple and accessible and complied with WCAG 2.1 guidelines.

Sitbon et al. (2019) presented the lessons learned from a participatory design process that focused on understanding the engagement and preferences of users with ID viewing 360° videos. Important parameters were image quality and stability, pointing in the videos, social engagement, the existence of a mirroring application, and participants' interests in themes. Design considerations included specific viewpoint preferences, speed when rotating the camera, preference for a in-video facilitator instead of symbols as arrows and scaffolding of the experience.

Communication

Mongeau & Lussier-Desrochers (2017) investigated tablets as a tool that offers communication, through the combined use of AAC systems. In their study that included adults with ID, they highlighted the importance of supporting digital inclusion for persons with multiple disabilities. They concluded that there are major benefits associated with the introduction of tablets as a tool of this type. Tablets are also used by persons without disabilities; thus, they were reported to be accessible and accepted by the persons with intellectual disabilities and meet intervention expectations. They noted, however, that a large number of persons with intellectual disabilities still use low tech or dedicated AAC systems, and this was initiated before the latest technological advance. Hence, reviewing AAC systems in light of new technological advancements, will help ensure full digital inclusion for persons with intellectual disabilities.

Social media

Backman et al. (2018) conducted a study on introducing web-based, coach-guided intervention course for adolescents and young adults with autism spectrum disorder. The participants of the study showed increased performance and satisfaction with the course outline which helped them to access social media. The study successfully extracted the understanding of facilitators and the barriers to social media usage of the end user with ID, whereas a number of potential strategies were identified to address the common challenges.

Bonilla del Río et al. (2022) investigated how the use of social networks allowed 10 persons with Down syndrome (mostly women) to take part in the digital environment, make their interests visible and interact with audience/followers. Their conclusion wat that the participants (micro-influencers and macro-influencers who have professions as models, cooks, digital creators, or YouTubers) are considered positive influence that promotes respect for diversity. Influencers formulated questions in the descriptive text that were directed towards the users and generated interactions with their followers through their comments. The publications with a higher number of positive interactions were associated with lifestyle, activities, or celebrations in their day-to-day lives.

White et al. (2020) adapted the Social Network Guide (system for measuring the structural, interactional, and supportive aspects of individual's networks) according to the needs of adolescents (age 14 to 17) with and without ID. They recorded that the use of social media would not increase the size of the social network of the persons and, therefore, suggested individualized training, and that social media use was predictive of the number of reported friendships, although it was not associated with critical comments.

Sitbon et al. (2021) created a framework to evaluate accessibility large video repositories. The framework focused on search (browsing) accessibility and proposed the following:

- Establishment of web accessibility (accessibility of menus or buttons with a screen reader).
- Search (or browsing) accessibility (accessibility of interactions with the system)
- Media accessibility (whether a search result itself, in this case a video, is accessible).
- Access to available information, organization and presentation of information and provision of this information provided through video media that can reached by users in their terms.
- Attention to certain aspects of search accessibility and media accessibility of a large video repository.
- Evaluation of video platforms in terms of relevance, retrievability, and quality.

Martins et al. (2021), conducted a literature review regarding the needs of, attitudes towards, patterns of use of digital media by individuals with ID, and the guidelines that must be followed when developing accessible digital solutions. Following that, they created "amik@", a social media platform for persons with intellectual disabilities. These identified the specifications of the system, and these are presented in Table 3, divided in technical and functional requirements:

Table 13 *Technical and functional requirements of a social media platform (adjusted from Martins et al.,2021)*

Technical requirements of amik@	Functional requirements of amik@
android User	periodic scheduled videocalls
iPhone User	extra videocalls in case of need
compatible with smartwatches	appointments for scheduled activities
compatible with desktop, laptop and tablet	appointment alarms for scheduled activities
access to camera, microphone, location and contacts	agenda for scheduled activities
live streaming	FAQ's including visual and audio guide
	advice on emergency situation
	recommended and established exercises (with videos and photos)
	exercises - log
	exercises - scheduled
	exercises alarms and reminders
	blog
	chat
	podcasts
	videocasts
	integration with social media
	points of interest
	local weather

Social inclusion enhancement

Cuascota et al. (2019) presented the development and evaluation of a tool for Android smartphones designed to assist persons with cognitive disabilities regarding tasks for their social inclusion. The system used Beacon technology to locate the positioning of the user and perform an analysis of their behavior, during the execution of tasks. Parameters considered were time, assistance, errors, and aid provided in the various activities. All these parameters showed improvement in the participants with lower cognitive abilities.

Education

Mateos-Sanchez et al. (2022) described the benefits of using Chatbot, an android mobile application with artificial intelligence, as educational and inclusive tool for persons with intellectual disabilities. The Chatbot facilitated interaction and communication with the use of voice or text, addressing the diversity of users. It assisted them in the development of their social skills, and also in becoming active agents of change by providing available resources.

Iatraki et al. (2021) investigated design issues regarding the development of digital learning environments that contribute to Science Education for students with ID, through the three-dimensional representation of invisible phenomena. Different stakeholders and a person with ID evaluated a system of an augmentative and virtual reality system that depicted molecules' structure. Lightweight glasses were considered comfortable. Considering the affordances of the system, the conclusion was that general education guidelines were preferred, with molecules that are coloured and more engaging, although in reality these are colourless. Number of molecules depicted was considered adequate, but there was a request for the molecules to move slower and be bigger. Augmented reality system provided lower resolution of molecules, nevertheless, it allowed more freedom in movements, with the person not being isolated and being able to see where they are in the room. On the other hand, current version of the virtual system ran smoother than the augmented and gave a motivation to wander in space, nonetheless, it seemed more fake. Ultimately, the decision of using the augmented or immersive virtual environment depends on the characteristics, preferences, and academic profile of the students with ID. Teachers commented that the system allowed the teaching process to be divided into smaller and simpler steps.

Wu et al. (2020) applied the "Virtual Reality Vocational Skills Training System" to vocational high school students with ID, simplifying the operation of a pre-existing system and developing an easy-to-use game version. They concluded that the easy-to-ready system required less time to complete the tasks, had greater accuracy concerning the implementation of tasks, involved less movement errors and ranked better regarding usability. Ultimately, persons with intellectual disabilities only needed some assistance in setting up the system before entering the system (game) and they were more autonomous during the next stages.

Cinquin et al. (2018) reported that Massive Open Online courses (MOOCs) have become increasingly important in education sector, and this is true especially after the pandemic emergence and the need of many educational institutes to adapt to online courses. The authors' accessible MOOC Player (named "Aïana") was reported to be a promising tool that gives persons with disabilities the opportunity to develop new skills and become more competitive in gaining employment. The

researchers conducted research including persons with various types of cognitive disabilities and expert professionals, to develop this MOOC player. The player introduced key design features, such as accessible self-configuration, additional access window, semantic navigation, multiple displays for teacher and students, etc. The authors concluded that “Aiana” could assist persons with intellectual disabilities to achieve autonomy and competences, which was deemed important to motivate them while participating in distance learning.

Searching and evaluation of information

Delgado et al. (2019) tested an instructional programme addressing the need to increase the skills regarding evaluation of information from the internet. Participants who used the programme were reported to have become more effective in selecting trustworthy web pages. Participants also justified their selection by referring to source characteristics, by means of supervised instruction.

Roomkham et al. (2022) developed a preliminary version of a simulated multi-modal conversational search system and examined its potentials and limitations for persons with intellectual disabilities, considering their accessibility and information retrieval needs and user experience. Voice queries were not possible to the extent wanted with current systems. "Seek assistance" was considered as a stage of information retrieval, thus, it should be allowed for support workers and users to speak together, in the context of a “conversational search”. Another important point being recorded, is that different types of modality presentation are currently reducing the “system’s” response time. A multi-modal presentation of the system should work towards a response, such as an animation or spoken statement about the process, potentially including a repetition of the query. Regarding that, responses should be more natural, and for ease of use, they could be predefined.

Transportation

Seatjata et al. (2018) investigated the co-design process for a transport application addressing the needs of persons with intellectual disabilities. Combined with a number of accessibility features, this application assisted persons with intellectual disabilities to navigate independently using public transport. After rounds of interviews and trial sessions, the research team developed a high-fidelity prototype, which increased end user’s understanding on different features and functionality of the application (e.g., how to choose the exact time of their journey, how to define an alternative route, etc.). The author’s findings also suggested the need to further explore the user perspective on the notion of accessibility of public transport, which is not driven by data or engineering, but associated and adapted to understanding of use, inclusion and social support.

Everyday living

Koushik et al. (2022) investigated the way that smart devices can expand their features to support customized prompts of augmented reality for person with cognitive disabilities. They studied types of customizations that could assist and motivate individuals to stay on tasks and complete them more independently. They also studied perspectives and concerns of this community in using a smart display for everyday routines.

Safety in everyday life for a person with intellectual disabilities

Venkatasubramanian et al. (2021) developed of a mobile computing-based reporting tool for empowering individuals with IDD to self-report abuse. It was concluded that any reporting tool should also be accompanied by a separate or integrated learning tool, and it should be used with a tablet. The person should be able to communicate the details of abuse and any resulting injury with the reporting tool, and at the same time, the reporting tool should be secured from abusers. Regarding this, it is important to leverage the typical interdependence with others and involvement of trusted third parties. Regarding the learning tool, that should be engaging, without diminishing the seriousness of the topic. It would not constitute a complete module of abuse training, but rather, it would refresh concepts after attending a workshop. Lastly, contact with the appropriate agency should be automated, meaning that the agency should adapt their workflow, to receive information from the users of the application.

Gamification

This is a category of good practices that can be combined with other categories but encompasses the use of gamification. It is important to note that not all issues are appropriate for gamified experiences (e.g., Venkatasubramanian et al., 2021).

Torrado et al. (2020) examined the development of an android exercise game that intended to motivate persons with intellectual disabilities to exercise physical activity outdoors, by walking, while having a gamified experience. The results of the study were twofold: A working prototype of the exergame, to motivate users with ID to do hikes, and an example of a practical engineering methodology that considers specific requirements and constraints of the e-health domain. As it turned out, having social interaction during the physical activity turned out to be a major motivational aspect of the system, whereas rewards systems did not attract much of the users' attention. Ultimately, regarding the adapted navigational assistance, easy-to-read text, visual communication, and street-level pictures that would lead to achieving successful and understandable guidance outdoors for persons with intellectual disabilities.

Employment practices

The current report also presents employment and ICT good practices from different countries, identified after a web-search. The type of barrier is specified in this table (Table 4). These practices are not included in Annex B and are not a part of the two initial queries.

Table 14 *Employment practices identified from a web-search*

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
1. Job clubs as employment entry points for persons with intellectual disabilities, Instituto Clemente – Professional Inclusion, Brazil	Insufficient support for employment of persons with intellectual disabilities in Brazil [Barrier Type: ACCESS due to not having access to services]	Persons with intellectual disabilities can have *meetings with a job coach* that will help them improve their skills and self-esteem. This organisation has developed a model that has three components: 1) job clubs, (2) supported employment, and (3) community-based-rehabilitation (CBR). Impact: It assisted 500 persons with intellectual disabilities to get employment in 2019 and has 90% retention. Contact: Mr. Lucas Alonso lucas.alonso@ijc.org.br – www.ijc.org.br
2. Employer-driven job creation for persons with intellectual disabilities, Lev – Inclusion Denmark – KLAPjob, Denmark	Municipal job centres. Denmark does not need to comply with any laws for persons with intellectual disabilities. Many persons with intellectual disabilities are employed in	KLAPjob organisation is collaborating with many employers to offer employment to persons with intellectual disabilities, in unskilled part time jobs. Impact: This organisation assists persons with intellectual disabilities to get more disability benefits (increase by 25%) as per their working hours. From 2014 to 2019, they assisted 3.684 persons with intellectual disabilities to get employment. Contact: Ms. Sune Barker sb@lev.dk – www.lev.dk

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
	sheltered workshops. [Barrier Type: ACCESS due to not having access to services]	
3. Assigning job coaches for young jobseekers with intellectual disabilities, Cope Foundation – Ability@Work, Ireland	Absence of dedicated employment for persons with intellectual disabilities [Barrier Type: ACCESS due to not having access to services]	Ability@Work provides job coaches that assist young persons with intellectual disabilities to connect with local organisations to seek for employment and further assist them to apply for relevant jobs. Impact: They assisted 44 people to get employment. Contact: Ms. Daragh Forde forded@cope-foundation.ie – www.cope-foundation.ie/AbilityWork
4. Internships for persons with intellectual disabilities at a leading consultancy office, TCPID – Graduate Internship Programme, Ireland	Lack of higher education and unemployment [Barrier Type: ACCESS due to not having access to services]	TCPID is collaborating with many organisations to assist persons with intellectual disabilities get higher education and employment. Impact: In 2017 -2020, they offered training to six persons with intellectual disabilities, which further resulted in four permanent job placements. Contact: Ms. Marie Devitt devittma@tcd.ie – www.tcd.ie/tcpid
5. Training people	persons with	Itworks is offering training to persons with

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
with psychosocial and intellectual disabilities for ICT jobs, itworks – Technology Accessibility Program, Israel	intellectual disabilities receive less monthly income in Israel [Barrier Type: ACCESS due to not having access to services]	intellectual disabilities to become employed in technical sectors, such as quality assurance and helpdesk services. Impact: From 2011 to 2020, this organization trained around 230 people with disabilities, and 74% of them got employment. Contact: Ms. Nitsa Bucritz Ford nitsa@itworks.org.il – http://itworks.org.il
6. A work coach model for persons with intellectual disabilities, Sana – Sana Work Program, Jordan	In Jordan, persons with intellectual disabilities have neither enough job employment opportunities, nor consistent wages [Barrier Type: ACCESS due to not having access to services]	Sana program use a Japanese model. This model includes four important septs: 1) Identification of persons with intellectual disabilities needs, according to health, education and other support needs. 2) Interactions with employers, as well as assessment of the prospective workplace, 3) Job compatibility and appropriate modifications, 4) In-depth workplace training from a work coach until the new employee can function independently. Impact: in year 2020, 80 candidates gained employment, out of 150 candidates. Contact: Ms. Alia Juma aliajuma.m@gmail.com – https://sana.org.jo
7. NGO federation training and	There are fewer work and training	Inclusion Mauritius provides educational training in easy language.

	Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
	placing young adults with intellectual disabilities, Inclusion Mauritius – Supported employment, Mauritius	options for persons with intellectual and developmental disabilities. [Barrier Type: ACCESS due to not having access to services]	Impact: They have provided training to 162 young people with intellectual and developmental disabilities, 50 of them got employment. Contact: Ms Pooja Gopee pooja.inclusionm@gmail.com – www.inclusionmauritius.org
8.	Vocational support for persons with intellectual disabilities, within the penal system, APSA Penitentiary Programme, Spain	Less services for persons with intellectual disabilities to get employment after going through the penal system [Barrier Type: ACCESS due to not having access to services]	APSA provides a rehabilitation and training program in easy language to facilitate employment for persons with intellectual disabilities. Impact: Supported 65 persons with intellectual disabilities in 2020 Contact: Ms. Maria José Juan Vera direcciontecnica@asociacionapsa.com – www.asociacionapsa.com
9.	Making civil service positions accessible for persons with intellectual	Public Sector is not aware regarding how to make recruitment process	Plena Inclusión España is working with public administrations at the local, regional, and national level, to make their recruitment process accessible.

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
disabilities, Plena Inclusión – Public Sector Employment, Spain	accessible [Barrier Type: ACCESS due to not having access to services]	Impact: Facilitated by their services, 448 people got employment during 2012 to 2020. Contact: Ms. Silvia Muñoz silviamunoz@plenainclusion.org – www.plenainclusion.org
10. Government-led training and hiring services for PwiID, State of Vermont – Transition Program, USA	The State of Vermont provides different educational services that are often confusing to participants [Barrier Type: ACCESS due to not having access to services]	State of Vermont – Post Secondary Education (PSE) provides two kinds of services for employment of persons with intellectual disabilities, and one service for lifelong learning. Impact: In 2019, this organisation offered services to 200 young people and 84% of them got employment. Contact: Ms. Jennie Masterson jennie.Masterson@vermont.gov – www.vermont.gov
11. Person-centred job training and employment for people with disabilities, BANGLADESH – DHAKA/PFDA-VOCATIONAL TRAINING CENTER,	Insufficient services for intellectual and developmental disabilities in Bangladesh [Barrier Type: ACCESS because	PFDA provides vocational training to person with intellectual disabilities and developmental disabilities. Impact: They have provided training to 450 people from 2014 – 2019, 300 people got employment Contact: Ms. Sajida Rahman Danny autismbangladesh@gmail.com – http://pfda-

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
Bangladesh	not having access to services]	vtc.org
12. Two restaurants run by persons with disabilities, HUNGARY/KÉK MADÁR ALAPÍTVÁNY – ÍZLELŐ RESTAURANTS	Only 1/3 of persons with intellectual disabilities get employment in Hungary and some are doing segregated work [Barrier Type: ACCESS due to not having access to services]	Kék Madár Alapítvány is a Hungarian NGO that has two restaurants. They create employment opportunities for disadvantage peopled (with physical disabilities and intellectual disabilities). Impact: They employed 39 people in 2020, and would like to do further expand their services. Contact: Ms. Kiry Noemi Ambrus ambrus.noemi@izleloetterem.hu – https://izleloetterem.hu
13. Transforming sheltered workshops to offer vocational training and employment support, SOHWA ARAM VR CENTRE – JOB PLUS, SOUTH KOREA	It is difficult for persons with intellectual disabilities who work in sheltered workshops to move to open labour market [Barrier Type: ACCESS due to not having access	SOHWA ARAM VR Centre provides vocational training and employment support for persons with intellectual disabilities. Impact: 34 participants got employment through this project from 2018 to 2020. Contact: Ms. So Hee Lee yeoul2006@daum.net

Innovative practice, organization, country	Barriers/ challenges being faced in employment for persons with intellectual disabilities	Innovative practice that removes barriers as Good Practice
	to services]	

Conclusions

Combined with conclusions in question 3.

Research question 3 and results - Challenges, barriers, and accessibility issues

Based on the analysis of the literature reviewed in this study, the main challenges and barriers concerning accessibility were identified.

Summary of challenges, barriers and accessibility issues

Main challenges and barriers are firstly presented in Table 5. These are presented from a high-level approach (state) to a low-level approach (the individual with ID) and ultimate consequences regarding the use of ICT. A background colour has been used, in order to assist the reader in finding this important table more easily:

Table 15 ***Barriers and challenges when persons with intellectual disabilities use ICT***

Barriers and challenges when persons with intellectual disabilities use ICT
Government and other stakeholders
high cost and lack of public funding for "non-essential" and assistive devices
strong eligibility criteria for public funding (especially for persons with mild to moderate ID)
high cost of digital devices, internet connection, training fees
lack of sustainability of a project after the end of its lifetime
different governmental definition of accessibility
different stakeholders not being a member of the team
lack of interdisciplinary research
worsening of the situation during COVID-19 pandemic
General societal and attitudinal level
accessibility: not always digital and physical and social
compartmentalization of research
lack of awareness for the need to create accessible sites
less emphasis in adulthood and workplace
lack of opportunity to use in all environments (or need to use different devices or no opportunity to use personal device)
lack of community integration
digital technology in the back end (e.g., IoT)
stigma for the use of non-mainstream technology
Services level
non specified mission statement of NGOs

Barriers and challenges when persons with intellectual disabilities use ICT

absence of an associated working group in organizations

absence of services in some geographical locations

lack of procedures of needs assessment

persons with intellectual disabilities not being asked regarding their wishes during

lack of training/ up-to-date training (persons, staff, carers)

lack of netiquette training

lack of peer training opportunities

training without UDL specifications

lack of flexibility during training

lack of support (technical and social)/ (person, staff, carer)

signaling for follow-up and maintenance usually only by the carer

hiring of technical staff without strong technological skills in NGOs (due to low career opportunities for them)

lack of technology acceptance among members of the staff and carers (fear, shame)

lack of awareness about the importance of technology among members of the staff (achievement of persons with intellectual disabilities's goals)

opinion (staff members) that older persons with intellectual disabilities don't want to use

lack of awareness of differentiated strategies needed for the training of older persons

lack of opportunities to experiment in tandems (staff)

support only after the escalation of a problem

insufficient planning and coordination during transition periods (e.g., towards employment)

Parameters of the system - more general

cognitive skills of the persons with intellectual disabilities not addressed (e.g., memory, decision-making, managing new circumstances)

motivation, personality, emotional and social skills of the persons not addressed

need to use different platforms for all needs that are to be addressed

inaccessible design (e.g., lack of boundaries between areas with differentiated functioning)

Parameters of the system - more specific*

Barriers and challenges when persons with intellectual disabilities use ICT

use of too much text, small-sized text, text in other language, inadequate font-style (3)

use of abbreviations, especially without explanation (3)

use of percentages and too many numbers (3)

lack of understandable language, wrong grammar, confusing instructions (1), (3)

use of passive voice (3)

use of negative sentences (3)

no use of visual cues to denote change of section (2)

lack of adequate pictures (3)

inadequate foreground-background coloring (3)

too many animations (5)

lack of predefined responses (2)

lack of adequate speech technologies (8)

lack of customizability (8)

lack of opportunity to correct errors (4)

lack of suggestions for reformulations of search and conversational search (4)

too many links (5)

lack of summary (1), (2)

difficulty to manage notifications (8)

non-specific thumbnails (2)

advertisements (5)

problematic registration/ credentials/ authentication procedures, very often met (1)

lack of adequate differentiation between log-in for primary or admin users (1)

lack of progress bar (horizontal rather than vertical) (7)

lack of internet connection

slow browsing speed (2)

inadequate infrastructure or interoperability (e.g., Wi-Fi, AAC) (8)

rapidly changing technology (1)

battery drain (7)

difficulty to replace battery (7)

Security/safety, acceptance and agency issues

Barriers and challenges when persons with intellectual disabilities use ICT
system security
safety concerns (e.g., bullying, circulation of personal information, financial risk, grooming
lack of opportunity of the persons with intellectual disabilities to decide for themselves
lack of technology acceptance and understanding of opportunities and impact by the persons with intellectual disabilities themselves
Ultimate probable result regarding ICT
abandonment of technology (especially for persons with severe and profound ID, less probable for persons with other levels of ID, when living in service organizations)

*Note: items in *Parameters of the system* have been allocated to COGA Guidelines, with the use of numbers:

1. Help users understand what things are and how to use them (1)
2. Help users find what they need (2)
3. Use clear and understandable content (3)
4. Help users avoid mistakes and know how to correct them (4)
5. Help users focus (5)
6. Ensure processes do not rely on memory (6)

A short analysis of each relevant publication and study (regarding this question) is presented in the following section:

Publications discussing challenges, barriers, and accessibility issues

The presentation of information of each relevant publication, regarding challenges, barriers, and accessibility issues, is presented below. This section was considered useful for the reader who wants to delve into this information and its origin through the publications. These publications are grouped in the following categories:

- Theoretical publications
- Cognitive, social, emotional barriers
- Inputting information
- Comprehending content
- Finding the most important information on a webpage
- Understanding and using controls
- Summarizing

- Safety issues
- Publications with findings in a number of areas of challenges, barriers, and accessibility issues
    - Literature reviews
    - Studies with human subjects
        - COVID-19 related research

Theoretical publications

In their suggested framework, Sitbon et al. (2020) recorded the following barriers, concerning search in a large repository of videos:

- Lack of ability to skip content
- Menus or buttons were not always accessible with a screen reader
- There were issues concerning the relevance of the content, their retrievability and their quality.
- There were not adequate suggestions for reformulation of search.
- Results were not adequately categorized.
- Advertisements could be very annoying.

Nguyen et al. (2022), in a publication that promoted the creation of a conceptual framework for key dimensions of digital inclusion in general, identified four feature categories in the digital accessibility layers: availability, connectivity, affordability, and assistive design. Digital acceptance was also considered important and refers to the understanding and attitudes towards the use of digital technology. This dimension contains the awareness of technology, perceived usefulness, perceived usability, and perceived trustworthiness.

According to Bayor et al. (2018a), adults with intellectual and physical disabilities need assistive technologies, whereas socio-technical issues that adversely affect participation of a person with ID in the digital space are the following:

- low digital literacy
- complex authentication process, e.g, log-in, password retrieval protocol, etc.
- lack of understanding of social norm and netiquette
- inaccessible design issues, e.g., small microphone icon
- frequent advertising interruptions

According to FUNKA (2022) and their guidelines that can assist the designer, developer, and tester to develop applications for persons with intellectual disabilities, these are the barriers for use of ICT solutions:

- The provision of access to assistive technologies is very important.
- Software upgrades and modifications that need relearning may constitute a significant barrier.
- There are many obstacles for the use of technology in the classroom, including unavailability of technical infrastructure, as well as unreliable internet connection.
- Incompatibility has been identified between current technology and the demands of students for learning.
- There are system-specific incompatibilities, in which the care facility's current systems are not compatible with digital gadgets.

The Buddy platform by Johannes Kepler University and FUNKA (2022) assists persons with intellectual disabilities to access assistive technologies.

Cognitive, social, emotional barriers

Terras et al. (2018) specified that the existing evidence base in e-learning or other game-based learning highlights the importance of influences of user's psychological profile and context (e.g., limited attentional and memory resources), however the socio-emotional profile (e.g., motivation, personality, emotionality and social skills) of users is mostly neglected.

Ní Shé et al. (2021) identified the psycho-social and information support needs of adolescents and young adult cancer care consumers with ID have and recorded that there was lack of appropriate communication tools.

Egard et al. (2021), examined how society changes with new digital technologies, and how this can create new disabling barriers in everyday life. Barriers that persons with intellectual disabilities met were not specified (in relation to specific disabilities). It is interesting to note that accessibility or inaccessibility was categorized as digital, physical, or social. Changes that appear insignificant at first sight can have a substantial impact on the daily lives of persons with disabilities. When older technologies would be brought together with digitalization processes, both old and new barriers could arise. Also, digital technologies could construct disabling barriers in mundane contexts, even in some non-digital contexts where there is digital technology in the back end, as for example, the Internet of Things.

Kjellstrand et al. (2022) mentioned technical and social barriers in accessibility for persons with intellectual disabilities and cognitive disabilities. They also recorded difficulties and barriers concerning the following parameters:

1. Different aspects of cognition and different forms of cognitive disability affect accessibility.
2. Steps taken to improve cognitive accessibility are not being comprehensively evaluated.

3. More cross-disciplinary research is necessary since research into cognition is currently compartmentalized.
4. Current research is focusing mostly on children and the elderly, and much less in adulthood or in workplace accessibility issues.
5. More accurate description of the impact of barriers on the individual is required.

Difficulties addressed in the design framework by Chang et al. (2021) were the following:

- Registration, credentials and authentication, skill pre-assessments
- Usability, adaptive design, responsive design
- System security and testing, usability testing, system security
- Education strategies, cybersecurity awareness, system training

The authors also note the necessity to include solutions such as serious gaming and digital mental health in upcoming, alternative frameworks.

Inputting information

Bayor et al. (2018b) proposed that persons with intellectual disabilities could largely be benefited from speech technologies such as voice assistant to access information from internet. Voice assistant would allow them to complete tasks faster with less assistance. However, they noted that this technology would not be beneficial for persons with speech impairments.

Comprehending content

Alfredsson et al. (2020a) investigated the digital participation of adolescents with ID and concluded that they find it difficult to understand information they find on the internet.

Regarding a very specific and demanding context, Cinquin et al. (2018) concluded that most of the existing MOOCs are not fully accessible and in most of the cases, accessibility was not considered when developing them. Lack of correct and cohesive language and inaccessible design ultimately was reported to risk the exclusion of persons with intellectual disability to use them.

Finding the most important information on a webpage

Arachchi et al. (2021) explored the way that young adults with ID, who had not previously used the internet, interacted with Google search. They concluded that too many links in the text increased the cognitive load, and that result lists with summaries would have been helpful for novices in selecting the relevant results.

Roomkham et al. (2022) developed a preliminary version of a simulated multi-modal conversational search system and examined its potentials and limitations for persons with intellectual disabilities, considering their accessibility and information retrieval needs and user experience. Voice queries

were not possible to the extent wanted with current systems. "Seek assistance" was considered as a stage of information retrieval, thus, it should be allowed for support workers and users to speak together, in the context of a “conversational search”. Another important point being recorded, is that different types of modality presentation were currently reducing the “system’s” response time. A multi-modal presentation of the system should work towards a response, such as an animation or spoken statement about the process, potentially including a repetition of the query. Regarding that, responses should be more natural and could be predefined (as an option).

Understanding and using controls

The Buddy platform (Johannes Kepler University & FUNKA, 2022) assists people with cognitive disabilities to interact with digital services by using assistive technology. In this platform, five difficulties are being addressed: 1) Clickable objects, 2) Interactive elements, 3) Understanding of important information, 4) Indication of progress, 5) Users location access.

Summarizing

Balasuriya et al. (2021) investigated the abilities and preferences of persons with intellectual disabilities when obtaining information from web pages that had been automatically summarized, or full-length standard web pages. The most important barrier was the lack of perceived relevance, in relation to the person’s interests. Summarized articles were more easily read, especially when they had larger font. Sometimes, a single unknown word could make the person with ID stop reading. Lack of pairing text with images was also a problem when complicated words were used. The search engine did not support different literacy levels. Thumbnails should describe the content of the media. Also, lack of regular of exposure to devices was reported to be a barrier.

Safety issues

Caton et al. (2022) considered important the investigation of internet safety issues, such as cyberbullying, financial, and sexual exploitation, unwanted messages for persons with intellectual disabilities, and terrorism. Students were reported to be educated about "grooming" and they were themselves confident that they could face these issues, but parents were concerned whether their children could make a connection between grooming and extremism and radicalization. Some parents were more concerned and would actually think that even though their children were trained concerning “grooming”, when “they're in that moment, it's different”. Regarding teachers’ perceptions, they were concerned about adequate support to students when they were being exposed to potential risks while on internet.

Publications with findings in a number of areas of challenges, barriers, and accessibility issues

Literature reviews

Laurianne et al (2018) conducted a literature review that identified the most common obstacles a person with ID faces to access information from internet. These were reported to be: define correct query for search, correctly spelling search words, selecting a relevant link from a large selection, recalling procedures. However, the authors argued that these cannot be generalized to the persons who cannot read and spell.

Hortizuela et al. (2021), in a literature review, presented an overview of the current state of web accessibility for people with cognitive disabilities. Probable barriers are that not all governments have adapted the definition of web accessibility by the World Wide Web as to how to make web content more accessible. Thus, there are difficulties in accessing the web specifically on processing too much content or information, confusing instructions, typographies, and grammar. There are also non-conformity issues across different websites of distinct purpose like for education, public service, and social networking (illegible text, issues on robustness, lack of content hierarchy, too many animations, and content heaviness). Other parameters mentioned were the lack of awareness, compassion, and understanding of the guidelines, that lead to failure of websites to comply.

Khanlou et al. (2021), in a literature review, examined the barriers to access and utilization of digital technology to support the transition stage needs (in relation to education, daily living, community integration, and employment) of young adults with developmental disabilities. They recorded the following barriers:

- Education
    - Lack of training for teachers, parents
    - Affordability
    - Poor follow-through in technology support services from secondary to post-secondary settings, which led to equipment abandonment
    - Inadequate infrastructure or interoperability (e.g., Wi-Fi, AAC)
    - Lack of adequate functional design (poor integration of AAC with cell phones, overly complex interface, weak voice synthesizers, confusing screens, or speed and technical features that were not individualized enough)
- Daily living
    - Unavailable training
    - Inadequate support for parents
    - Complex design

  - Lack of fit with needs
  - Inadequate user interface usability-system support (features did not consider the comprehension and decision-making challenges or lack of life experience of the young adults)
  - Lack of appropriate "technology fit", which was considered as the most important barrier
- Community integration
  - Lack of availability of up-to-date technology (in relation to design, connectivity, and training)
  - Lack of social inclusion and lack of social acceptance for use of digital technology as aids or accommodations in community settings
  - Poor access to community activities
  - Complete absence of equipment and technological support beyond secondary school
  - Low levels of literacy
  - Economic disadvantage within the family
- Employment
  - Lack of availability of digital technology
  - Lack of appropriate design
  - Lack of provision of accommodations
  - Lack of provision of infrastructure
  - Insufficient planning through their transition phase from school to work or school to community

Studies with human subjects

Gibson et al. (2020) recorded that persons with intellectual disabilities had difficulties when they needed to communicate with their GP. Also, if they had to rely on family members to facilitate process to access a GP, they tended to withhold crucial information regarding their health.

Khan et al. (2021) investigated the main barriers to independent activities for young adults with Down's Syndrome and the way smart devices and applications helped young adults with Down's Syndrome to perform these activities. The most common challenge was reported to be travelling independently. Relevant obstacles were low decision-making skills, lack of suitable applications, cost of devices and mobile data services, manual dexterity, lack of information and knowledge (e.g., assistive applications), managing notifications, use of voice commands, new circumstances, too many instructions at a time, lack of progress bar (horizontal rather than vertical), incorrect design of the

interface, ordering of the content, text size, font style, colour, battery drain, lack of differentiation between log-in for primary or admin user with an adequate button.

Bakkum et al. (2022) examined the scientific evidence of the use and feasibility of information and communication technology (ICT) for social contact by persons with intellectual disabilities living in care facilities, and potential effects on well-being. Differences regarding type and level of disability lead to different skills in setting up accounts and learning how to use devices. Facebook use “did not feel like everyone else”, there was not joy using, there were feelings of stress and frustration when experiencing "technical and conceptual difficulties", feeling annoyed, e.g., due to unresponsive touchscreen. Specific barriers included:

- creating account, understanding Facebook jargon, literacy difficulties
- need for voice-call
- device, service provider, replacing battery
- perceived risks: by staff: harassment, victimisation by fraud, and circulation of personal information
- preconditions
- implementation: own devices such as smartphones and computers, micro switches with minimal time investment from caregivers or staff in general
- lack of support from organizations, support staff, and family/ might not know who to ask for help regarding the use of social media/ evasive answer/ choice made by parents

Song et al. (2020) analyzed whether technology could effectively promote the impact scaling of NGOs providing services for adolescents with ID. As recorded, persons participated less in the platform that was created within a project, after the end of the project, when there was not ongoing technical support and capital investment. 35% of respondents (unknown percentage of them were persons with intellectual disabilities) believed that the web version of the platform was of moderate quality. There were aspects of the platform that required “urgent improvement”, such as page layout, platform content, and platform browsing speed (87.5% of all responses). Also, interactive aspects of the original platform designs were unable to be implemented into the final product due to budget restrictions. Most NGO staff serving adolescents with ID in China are older individuals with low digital literacy and cannot assist persons with intellectual disabilities. Online training that took place for the staff had reduced efficacy concerning practical skills. It was also mentioned that, while standardization allows for the scaling of impact, it also leads to the loss of characteristic information, which reduces the ability to meet diverse training needs. Other parameters included lack of business literacy, mismatch between the technological solution and its target users with low digital literacy,

and difficulty to hire employees with strong technological skills, since career in a service-oriented entity is considered limited for them, with lower wages. In addition, NGOs are also unable to mimic the business models of for-profit enterprise.

Boot et al. (2019) investigated barriers and facilitators to effectively access and continuously use essential assistive products (AP) for persons with intellectual disabilities living in group homes in Ireland. Some of these could be attributed to high tech digital devices.

Initial access barriers identified were:

- Availability: the provider of AP should be available within close commuting distance to the user
- Assessment: the user should be involved within the trial and assessment of AP, in an environment that is suitable to them, to ensure the accuracy of the procedure. The carer should be involved, also.
- Attitudinal and social context: carers being familiar to new AP and carers should be open to new AP. Sometimes there is only emphasis on comfort, caring and medical needs, with less emphasis on development and participation of the person in society. It is recorded that mainstream AP positively influenced the attitudes of persons towards AP. What was also recorded, was the current paternalistic attitudes of carers and professionals to persons with intellectual disabilities, especially concerning high tech equipment, access to which could be prohibited.
- Financial: public funding was mainly available for AP that was seen as a basic need and comfort, while access to AP generally took longer. If public funding was used, there was long waiting list, with up extended waiting time.
- There are strict eligibility criteria, especially for individuals with a mild to moderate ID. For these persons, applications were grouped with applications from other populations in need of AP and were often assessed as being less urgent, which increased waiting time. It is important to note that a lot depended on the approach of the health professional to support access to funding. Also, consistency to AP support varied.
- Knowledge and awareness: carers reported a lack of knowledge on available AP and the benefits of AP use. Professionals often felt responsible to educate the user and carer about available AP, meaning they needed to be kept up-to-date on new, more appropriate AP. This often led to a feeling that there was a lack of (appropriate) training for them concerning the specific area.

- Increasing awareness among persons with intellectual disabilities about available AP could influence their motivation to access and use AP (e.g., peer learning).
- Organizational and systemic: gap between policy and implementation was reported to be enormous, with a need for improving guidance. It is important that the right people are involved in policy developments. In addition, current system for public funding could vary depending on geographical location. Initiatives like an AP recycling or lending center encouraged to decrease costs. It needs to be noted that, purchasing models for AP are not integrated into the national budget to reflect the shift towards community living. What also has not been stressed enough, is the importance of access to the mainstream workforce for persons with intellectual disabilities to have access to AP.

Continuous use barriers identified were:

- Abandonment: this is not common for users living at ID service organizations.
- Attitudinal and social context: most of the users didn't feel ashamed using their AP and liked their AP, especially when they had the chance to notice the benefit of the AP. Within the residential setting, all users felt included and received positive responses to the AP they were using. Nevertheless, when users would go into the community, negative responses from others were sometimes experienced. Also, if carers or family were being reluctant to new AP, for example because of shame or fear, the use of AP was expected to be less. On the other hand, mainstream AP helped to reduce stigma around AP.
- Customization: this is not always possible, although it could helpful. Multidisciplinary approach in necessary for that, nevertheless, customized AP could not be trialed, and it was unknown if the AP would be accepted and used by the individual.
- Environment: lack of internet is decisive, as is the actual size of AP, being unfit for use in relevant environment frequented by users.
- Follow-up and maintenance: standard follow-up for some of the AP was carried out. Sometimes it was the carers would signal the need for follow-up or maintenance. Other times, it was the users who signaled the need for a review themselves. Most of the suppliers would have a service to provide maintenance, but a waiting list could apply for that.
- Impact: if AP had not a certain impact in the user's life and enabled activities for the user, it was expected that the user would not continue using the AP.
- Knowledge and awareness: awareness of why AP was needed and understanding how to use the AP was important. Nonetheless, it is stressed that understanding the purpose of AP was not always possible for persons with a severe to profound level of ID. What was really

helpful, was individualized AP instructions to be available to staff. In addition, AP use was higher among persons who were able to independently use their AP, and the possibilities of peer learning increased use of AP.

- Support: the role of support is huge, regarding use in a daily basis.

Heitplatz et al. (2020) investigated the way that media education programs should be designed to meet the needs of persons with intellectual disabilities, their formal caregivers, and social institutions.

Opinions of formal caregivers:

- Suitability: those who cannot read often have no opportunity to participate. They need more time and explanation in plain language, more intensive hands-on, only one instructor, and might have difficulties with participation fee.
- Mobility: for those that live in “residential institutions”, there might not be enough employees in the institutions to accompany them. In-house education might not be visible due to fear. Also, quite often, institutions have only one device for education, that could be a PC and not a tablet.
- Lack of knowledge and skills: not all employees were familiar with digital media and the internet. In addition, there was a lack of ideas on how people with disabilities could benefit from digital media and the internet. In fact, they believed that older people are not supposed to be interested. In general, acceptance should be raised, and employees should be allowed to try out and test the digital media to make their own experiences and to gain understanding of what can be done

Opinions of persons with intellectual disabilities:

- Desire for social support: they need to know how to do things themselves, since they might by currently uncertain how to use them. There is also a sensitive level between being overprotective and providing too little support for questions and concerns of the participants. Sometimes, they felt that they were not taken seriously enough.
- Desire for education programs: attending a workshop is important, whereas institution might offer opportunities to use a computer room on certain days of the week, which is boring if they don't know what to do). Concerning safety, they need to handle Facebook, block, if necessary, in WhatsApp, and handle one's own data on the internet. It was possible that persons could deny the desire to learn more, although they were not acquainted with voice control or google maps.

Opinions of experts:

- Space for communication and experimentation: there was a need for the creation of space for digital topics (also physical) and for discussion. Adequate time and opportunity require pedagogical and methodological knowledge.
- Inclusive cooperation: it was important to work in tandems and be able to pass their own experiences. Also, it was recorded that employees and clients can learn from each other.
- Up-to-dateness: lack of pedagogical support leads to loss of interest and persons should be asked what they are interested in. Employees should be asked about up-to date topics that have a significant influence on their daily work (cyberbullying or sexting, already known in schools).
- Flexible structure: it was important to realize that the staff should not stick on their plan at every time, and be ready to use alternatives, such as symbols or photos. Modular structures are particularly suitable, meaning shifting the order of the topics according to the interest of the participants, as well as technical parameters, such as what people use and how they use it, negative sides of social media, secure passwords. Ultimately, persons should attend voluntarily and have the right to reject offers.
- Create relationships: what they would like to do, their hobbies and ideas, social gathering
- Mission statements of the institution: institutions must be aware that clients can be frustrated and fail. What is necessary is that the team of the institution can find a common positive position toward digitization and a working group would be helpful in that.
- Acceptance among employees: Technologies were often regarded as a hindrance to nearness with persons with intellectual disabilities. It was reported that it is important to think of digital media as a means to assist clients achieve their goals. Employees' opinions should be taken seriously and then they should be sensitized and educated.
- Course design for persons with disabilities: it should be based on general educational principles and specifically Universal Design for Learning, with the use of pictures and pictograms.
- Information and cooperation: More public relation must be carried out, as well as establishment of a staff unit or a coordinator who will identify funding opportunities). Networking with partners from science and practice to advance the topic further is important. Training in specific issues should not only be offered when the situation is already escalating, but on a long-term basis. In fact, workshop topics could be implemented immediately afterward in larger media projects.

Martin et al. (2021) investigated specific aspects of mobile devices and applications and the way that they are associated with the social inclusion of persons with intellectual disabilities.

Background attributes

- age
- gender
- socio-economic status
- highest qualifications
- language
- disability pension

Mobile devices and applications use

- who decides what devices and applications the person uses
- help needed with devices
- help needed with applications
- number of devices used
- number of applications used
- frequency of use

Social inclusion with family, friends, and work/volunteering

- it is easier for the person to stay in touch
- it is easier for the person to do things
- it is easier for the person to make friends
- it is easier for the person to feel that they belong

Family

- older participants make their own decisions
- older participants need for more help and use fewer applications
- non-English speaking participants make their own decisions
- male participants reported more staying in touch with their family

Friends

- participants with high socio-economic status mention less for belonging with friends and are more self-determined
- participants on disability pension: more for staying in touch with friends
- older participants: less frequent use in high education, more for making friends

Family-specific social inclusion

- self-determined: report doing things with family
- needing help: more keep in touch, less to do things with them

- more devices: more keeping in touch
- more frequent use: sense of belonging with family

Friend-specific social inclusion

- more apps: more keeping in touch, more things doing
- self-determined: stay in touch and sense of belonging

Working or volunteering specific social inclusion

- older: self-determined - need for help
- disability pension: stay in touch with work and make friends
- higher education: more things with friends at work

Schlomann et al. (2021) analyzed the learning strategies, preferences, and learning settings of older adults with and without ID, regarding learning ICT, with emphasis on self-regulation. They concluded the following:

- guided learning with personal explanations in a one-to-one setting was the most preferred learning format in both groups of older adults
- older adults with ID mostly relief on guided learning with personal assistance
- differences in abilities (e.g., reading skills) and social networks (e.g., living situation, having children) were important
- community organizations could provide additional support

Alanazi et al. (2022) investigated the perceptions and experiences of persons with intellectual disabilities concerning the use of smartphone applications for transportation by and the extent to which these applications improve their mobility. Issues that could be referring to other digital media and especially social media, are the following:

- the need to use a lot of buttons for one procedure is difficult
- not enough certain skills, such as time management, a long enough attention span, good problem-solving ability, and other cognitive-processing skills
- not enough appropriate training

Martins et al. (2021), in a literature review regarding the needs of, attitudes towards, patterns of use of digital media by individuals with ID, and the guidelines that must be followed when developing accessible digital solutions, concluded that their opportunity to use social media depended on the following parameters:

Digital information

- lack of screen reading programs or synthesized voice messages or short films with narrators
- no use of “meta-tag” on the homepage, with no “easy-to-read” words
- “pop-ups”
- very heavy programs that slow down the page or digital application display

Connections

- underlined words
- a call that is too long and is not hidden behind a small text
- not enough initial information on what information they’ll find on new pages
- lack of indication when a connection has already been visited (e.g., different colour)
- placement of links to another page behind an image because it's not easy to find

Screen appearance

- putting too much information on the screen and having to scroll down
- not placing text menu at the beginning of pages
- having to “walk to the right and left” to read the text
- not leaving space between paragraphs in the text of the screen
- putting things in motion on the screen

Written information

- use of words that are not simple enough or age appropriate
- use of words that people don’t know well and not using use the same word to describe the same thing
- lack of explanation of the subject clearly and lack of explanation of the difficult words whenever they need to be uses
- use of words from other languages despite the fact that they are not well known
- use of initials or abbreviations, especially without explanation ▪Avoid information with very large percentages and numbers
- no use of words like too much and too little to explain what you mean
- phrases that are not short and positive

McDonald et al. (2022) identified strategies for facilitating the inclusion of adults with ID as direct respondents in research. Concerning the format of the digital tool being used, the following were concluded that can be generalized, e.g., in social media use:

- using plain and consistent language and active voice
- few words

- breaking up complex sentences
- bullets
- words widely understood
- supporting words with informative visuals
- providing visual communication guides and conceptually grouping content
- avoid figures of speech or jargon
- sparingly using bold
- visual cues to denote each section

Alfredsson et al. (2020) explored the access to the internet and how it was used among adolescents and young adults with mild and moderate ID in their everyday settings. They recorded the following parameters:

- not having access to the internet in different settings
- having access in their own apartment in accommodated group homes, but access could be problematic and available staff couldn't help (and was not supposed to do so)
- not having internet access in their mobile (high cost was mostly problem for young adults, since parents paid for the students)
- big number of not personalized internet-enabled devices: no opportunity to use personal devices, often with touchscreens and an interface with applications, for example YouTube, that were arranged according to their personal preferences on the starting screen
- participants with no access to individually adapted devices could not take them between the work setting and their home
- different devices in different settings:
    - school: personal tablets provided by the schools ("fixed")
    - work: shared with others (desktop and tablets)
    - free time: smartphones and tablets (bought by parents, inherited from a relative or a family member - kept at home not to be stolen, decision of them or the parents), game consoles shared, siblings would talk parents into buying internet-enabled devices
- challenges when using the internet
- difficulties in reading, writing, and spelling: occasional or not
- rapidly changing digital environment: updates of software or new internet-enabled devices bought to the schools, new applications
- codes to unlock the different Internet-enabled devices are needed to even access and start to use the internet, to download applications, or enter social media

- strategies to handle the digital environment and take part in internet activities are not known
- not getting support from others when needed: parents, siblings (same age), staff
- lack of word-based strategies: correctly spelled notes (written by participants or by others), kept close, recognition in search engine (sometimes had to discontinue the search)
- lack of picture-based strategies: clicking on pictures (e.g., shortcuts), more than one device at the same time (filming things on the laptop, so as not to search for it again)
- lack of voice-based strategies or difficulties in articulation: using microphone (updating posts on social media, searching on the internet)

Bailey et al. (2021) investigated virtual reality and augmented reality (VR/AR) communication interventions for children, adolescents, and adults with communication disability and neurodevelopmental disorders, as well the feasibility of these technologies. They concluded that few adverse effects were reported (but these were considered probable), and that the presence of a VR/AR to support the person was identified as a key facilitator for adults with ID.

Senaratne et al. (2022) investigated the design, development, and evaluation of a curated set of accessible electronic modules, by adults with ID. Some useful conclusions were that there might be difficulties in understanding symbols. Lack of boundaries between areas with differentiated functioning could be problematic, as well as bad trade-offs in foregrounding and backgrounding and limited motor skills and.

COVID-19 related research

Chadwick et al. (2022) recorded parameters of access to internet during COVID. Negative factors were categorized as sociopolitical, structural, individual, and support related. Having no prior experience of digital participation, adequate finances, connection, support, and digital literacy mentoring for both persons with intellectual disabilities and those providing services, were negative indicators for access to internet during this period of time.

Specific challenges and barriers to digital inclusion and participation during COVID-19:

- dependent on support for access
- protection and security concerns
- dependence on carers to proxy access technology
- digital literacy skills and confidence
- lack of prior support and training
- loss of autonomy
- different tools and platforms
- cost of digital devices

- no internet connection
- sensory impairments
- dependence on carer
- inaccessibility of telehealth services

Facilitators of digital Inclusion during the pandemic:

- prior experience
- financial resources
- internet connection
- wished for more cognitive accessibility
- technical support
- living context
- training and support in ICT use for and by service providers and caregivers, who also benefit from peer technical support and mentoring
- netiquette guidelines by art therapists
- established relationship between service user and provider

Conclusions (question 2 and question 3)

These two sections considered comprehensive literature review on corresponding good practices and barriers and challenges of digital literacy for persons with intellectual disabilities the good practices are intended to address.

The evaluation of literature focused on identify the areas of digital literacy (based on the US Educational Testing Service, 2020, p.20) – access, manage, integrate, evaluate, create.

- Access: knowing about and knowing how to collect and/or retrieve information
- Manage: applying an existing organizational or classification scheme
- Integrate: interpreting and representing information. It involves summarizing, comparing and contrasting
- Evaluate: making judgments about the quality, relevance, usefulness, or efficiency of information
- Create: generating information by adapting, applying, designing, inventing, or authoring information

The reader can consult Annex B, regarding critical ETS competences addressed in every publication.

Digital literacy barriers can be divided in mainly two types: Social barriers, and barriers regarding technological solutions. In this literature review, barriers have been identified that could be allocated

in different groups: inclusion and involvement, standards and guidelines, ICT solutions, design challenges, education and training, and daily living of persons with intellectual disabilities. More extensively:

C**onsequences of these barriers:** These can be seen in day-to-day life of persons with intellectual disabilities, like access to online education and healthcare services, as well as employment (or the lack of it). The consequences pertain to not only in the lives of persons with intellectual disabilities, but also the whole society. E.g., companies can make less profit by excluding large groups of persons with intellectual disabilities. More cross disciplinary research is needed to evaluate consequences of barriers on the lives of persons with intellectual disabilities and the whole society.

Standards and Guidelines: There is less focus on the needs of persons with intellectual disabilities at different age groups. Consequently, persons with intellectual disabilities are excluded from rest of the society, which might further result in their disempowerment. Therefore, there is need to establish a common measurable understanding of the needs of persons with intellectual disabilities, to meet standardization purpose. Additionally, standardization can be improved with the involvement of this group. If the needs of persons with intellectual disabilities are addressed properly, then, persons with intellectual disabilities can also benefit from ICT solutions.

ICT Solutions: Regarding web applications, there is a need for more visual elements that meet the requirements of understanding, operability, orientation, and navigation, to create these applications. Additionally, it is difficult for persons with intellectual disabilities to gain an understanding of information, when there is too much of it in one page. Therefore, there is need to reduce the information on each website page. Awareness can be spread among persons with intellectual disabilities about available ICT solutions, and these ICT solutions will be then available to them in all areas of their life. If persons with intellectual disabilities need any training to comprehend and use these ICT solutions, then, this training should also be available in easy language.

Customization: Persons with intellectual disabilities can have different needs. Accessibility can be improved by customizing the interface as per user needs. More customization and personalization can be achieved with built in features and browser extensions.

Design: The design of web and software applications can be improved with the participation of persons with intellectual disabilities. Persons with intellectual disabilities can be experts in explaining their own needs to design team. In addition, it is required to raise awareness regarding guidelines and standards among design and development team members.

Accessible training and education programs: Digital literacy can be improved by introducing accessible environment for training programs and educational programs. The digital application for educational purposes must be provided in plain language, to ensure better understanding.

We can conclude that barriers can be removed with innovation in ICT solutions, as well as change in societal behavior.

Other interesting conclusions, regarding specifically social media, are the following:

- Regarding use of social media, participants with high socio-economic status are using them less for belonging with friends and are more self-determined.
- Siblings can play a crucial role in supporting the persons with intellectual disabilities.
- As shown in Table 13, a social media platform for persons with intellectual disabilities is considered as an application that can be combined with the opportunity to use a number of functions, according to the wishes and needs of the person.

In Table 16, the reader can be informed regarding the matching of barriers presented and good practices regarding guidelines that can address these barriers:

Table 16 *Barriers and Good Practices of guidelines that can address them*

Barrier	Good Practice
Integrated Development Environment is not accessible for developers with disabilities. ACCESS: Persons with disabilities are not able to access the tool.	Accessibility tips and tricks for Visual Studio: https://docs.microsoft.com/en-us/visualstudio/ide/reference/accessibility-tips-and-tricks?view=vs-2022
Inaccessible Android mobile Application issue. ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop applications for persons with intellectual disabilities to perform these functions.	• Best practices to design android mobile app to support accessiblity needs: https://material.io/design/usability/accessibility.html • Develop your app using best accessibility practices: https://developer.android.com/guide/topics/ui/accessibility/apps • Build more accessible apps: https://developer.android.com/guide/topics/ui/accessibility • Tool to test Android Mobile Application: Accessibility Scanner: https://play.google.com/store/apps/details?id=com.google.android.apps.accessibility.auditor

Barrier	Good Practice
Inaccessible apple mobile Application issue. ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop applications for persons with intellectual disabilities to perform these functions.	• Design guidelines for Apple products: https://developer.apple.com/design/human-interface-guidelines/foundations/accessibility • Develop your Apple app using best accessibility practices: https://developer.apple.com/accessibility/ • Tool to test Apple Mobile Application: Accessiblity Inspector: https://developer.apple.com/library/archive/documentation/Accessibility/Conceptual/AccessibilityMacOSX/OSXAXTestingApps.html
Inaccessibility regarding ICT Services, Hardware, Web, Non-web documents, Software, Documentation and Support Services, ICT providing relay or emergency service access. ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop applications for persons with intellectual disabilities to perform these functions.	• Guidelines for ICT products and and services: ETSI: HARMONISED EUROPEAN STANDARD, Accessibility requirements for ICT products and services: https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.02.01_60/en_301549v030201p.pdf

Guidelines for Internet Application: World Wide Web Consortium (W3C).
 	
ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop applications for persons with intellectual disabilities to perform these functions.
	• Guidelines for Internet Application: World Wide Web Consortium (W3C):
	  ○ Web Content Accessibility Guidelines (WCAG) 2.1: https://www.w3.org/TR/WCAG21/
	  ○ Draft Version: Web Content Accessibility Guidelines (WCAG) 2.2: https://www.w3.org/TR/WCAG22/
	  ○ Draft Version: Web Content Accessibility Guidelines (WCAG) 3.0: https://www.w3.org/WAI/standards-guidelines/wcag/wcag3-intro/

Barrier	Good Practice
Design Problems to make web applications accessible for people with cognitive and learning disabilities. ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop application for persons with intellectual disabilities to perform these functions.	World Wide Web Consortium (W3C): Making content usable for people with cognitive and learning disabilities: https://www.w3.org/TR/coga-usable/
Design of mobile ICT devices and their related applications for people with cognitive disabilities. ACCESS, EVALUATE, MANAGE, INTEGRATE, CREATE: These guidelines help the developer, designer, tester to develop applications for persons with intellectual disabilities to peform these functions.	ETSI: Human Factors; Guidelines for the design of mobile ICT devices and their related applications for people with cognitive disabilities: https://www.etsi.org/deliver/etsi_eg/203300_203399/203350/01.01.01_60/eg_203350v010101p.pdf

Research question 4 and results - Existing competence development for users and educators/ trainers of persons with intellectual disabilities

Educational Testing Service framework (ETS) has been used for the mapping of the findings of this literature review, as analyzed in Annex B. In this question, what is interesting is to find resources that will be helpful in defining existing competence development for users and educators/ trainers of persons with intellectual disabilities.

At the beginning of this section, a number of policies and legislation found after an additional web search are being recorded. Afterwards, results found from the publications identified in the two initial queries are presented.

Policies and legislation

- Access to quality education for children with special educational needs: This policy memo provides an overview of the policy and practice of EU Member States in offering children with special educational needs (SEN) access to education. https://ec.europa.eu/social/BlobServlet?docId=20625&langId=en
- Inclusive Education in Austria: Austria joined the Agency in 1996. The links provide access the details of Austria's national contacts, to find out more about its system for inclusive

education and to explore publications, country data, projects and news related to Austria. https://www.european-agency.org/country-information/austria

- European Agency for Special Needs and Inclusive Education: The Agency has 31 member countries, covering 36 jurisdictions (England, Northern Ireland, Scotland, and Wales, as well as Belgium's French, Flemish and German communities are each represented separately). This section contains information about each of the member countries: https://www.european-agency.org/country-information
- In the USA, The Individuals with Disabilities Education Act (IDEA) is a law that makes available a free appropriate public education to eligible children with disabilities throughout the nation and ensures special education and related services. https://sites.ed.gov/idea/about-idea/
- The DigComp 2.2 framework is very important regarding the mapping of digital competences, and has been used for the creation of the Entelis digital competence framework, regarding the needs of persons with disabilities. Key competencies for end user are: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving.

Information from publications

These are allocated in three groups:

- Concerning persons with intellectual disabilities
- Concerning persons with intellectual disabilities and carers of persons with intellectual disabilities/staff
- Concerning carers of persons with intellectual disabilities/staff

Persons with intellectual disabilities

The opportunity of persons with cognitive disabilities to use an online repository of digital assistive technologies is deemed important (Johannes Kepler University, 2022).

Hersh (2017) has created a classification framework for ICT-based learning technologies for persons with disabilities.

Cihak et al. (2015a) investigated the incorporation of functional digital literacy skills as part of the curriculum for high school students with ID. They concluded that important areas of teaching are emailing (sign in, reply to an email, send an email), bookmarking (save bookmarks, access Bookmarks), cloud storage (sign in, download, upload). Also, Cihak et al. (2015b) emphasized the

importance of teaching persons with intellectual disabilities how to email across multiple device platforms.

Andrew et al. (2018) conducted a study on 27 adults with ID and recorded that persons with intellectual disabilities mostly focus on viewing digital content in social media based on their interest. These persons showed competence in typing basic search queries (e.g., key words of interest such as "pizza" or "onion rings"), "Like", and re-share of posts and content. The authors also noted that participants found it difficult to search content in other areas of interests due to low literacy skills. Also, they recorded that many users didn't have the competence to autonomously create a user account, thus, they were not able to engage in activities such as creating a playlist in YouTube, uploading, and sharing content created by themselves, or subscribe to their favourite channel.

Sitbon et al. (2020b) investigated the effects of participatory design approach in interactive information retrieval (IIR) research and concluded that relevance also gets mixed with the notion of serendipitous learning.

Arachchi et al. (2021) identified distinct themes on strategies to support, build on, and develop the abilities of young adults with ID as they engage with Google search in their native language (for persons who had not previously used the internet). Basic conclusions from that are the following:

- Application of existing abilities: people already knew that they had to click somewhere, so they asked "where to click", they located and used the backspace key in the Google keyboard, and they used health issues that were interesting for them as search questions.
- Basic skills should match with learning needs: software or hardware selection should consider those.
- Conceptual understanding: it is important to provide a mental model, through the use of appropriate metaphors persons can be related to. Nevertheless, at times, participants' prior experiences misguided their conceptual understanding, and there was a need to increase the conceptual understanding related to the designer model to avoid mismatch (e.g., search vs enter key). Their familiarity with on-screen keyboard use was important, as well as their familiarity with phone usage.
- Animations to facilitate visual and associative memory: dynamic animations could support visual memory for those who needed it, selection could be made from URLs suggested, reading the snippets was helpful, support is necessary for them to understand the vertical arrangement of search results (they may seek and gather information horizontally rather than vertically). Also, teaching aids with "good visual/auditory" and step-by-step support that matches their level of understanding would be appropriate.

- Promoting active engagement: it was important for them to discuss Google search in groups and help each other, by discussing keywords to use in the search box, and discuss the search results page. Also, it was important that they were given some freedom to search for topics they were interested in, at least at the end of the session.

Roomkham et al. (2022) worked on the development of a preliminary simulated multi-modal conversational search system to understand its potentials and limitations for persons with intellectual disabilities. They concluded that collaborative search would be important, with the use of voice modality, although that is not possible at the moment. The importance of different type of modalities (i.e., images, touch, and voice) was emphasized, with user experience and satisfaction being important.

Persons with intellectual disabilities and carers of persons with intellectual disabilities/staff

Song et al. (2020) examined whether technology can effectively promote the impact scaling of NGOs providing services for adolescents, regarding the use of an online open-source educational platform (used by both the persons and the staff).

- They concluded that remote access to resources and education can expand the reach of innovations geographically and diversify learner groups, reduce training costs, and increase learning flexibility (given the freedom to choose their pacing, setting, content, frequency). This could also garner trust from the government and the public, by clearly displaying the organization's service standards and requirements.
- Nevertheless, they recorded that user growth tapered after the project ended, since the operation of an online open-source platform requires intense ongoing technical support and capital investment and needs to be of great quality, in terms of design and speed.
- Another difficulty was the mismatch between the technological solution and its target users with low digital literacy. Practical and hands on skills are difficult to present and teach effectively in online learning mode.
- Nevertheless, professional knowledge is more easily learned, with work values being somewhere in between, since trainees can learn about basic concepts through the online format, but to have a deeper understanding of its essence, they need to apply the concepts in practice while working with adolescents in the field.
- Also, the absence of real-time interaction was problematic, since organizations and instructors were unable to accurately verify that learning objectives are being met.

- The authors emphasized that social impact is not a product and that there is an issue of adaptability when relying on replication, since a standardized solution cannot be used to respond to all social issues and diverse training needs.

Heitplatz et al. (2020) investigated the way that education programs should be designed to meet the needs of persons with intellectual disabilities, their formal caregivers, and social institutions. They stressed the importance of the following factors:

- Suitability of the program: those who cannot read often have no opportunity to participate, need more time and explanation in plain language, more intensive hands-on training, only one instructor, difficulties with participation fee.
- Mobility of the persons: they might live in "residential institutions", so there may not be enough employees in the institutions to accompany them, whereas in-house education is sometimes absent due to fear or the existence of only one device (PC, not tablet).
- Lack of knowledge and skills: not all employees are familiar with digital media and the internet, and they lack ideas on how people with disabilities can benefit from digital media and the internet. Acceptance should be raised, and employees must be allowed to try out and test the digital media to make their own experiences and to gain understanding of what can be done.
- People's opinion matter: persons should be asked about their interests and employees should be asked about up-to date topics that have a significant influence on their daily work.
- Flexible structure: the employee should not stick on their plan at every time and use available modular structures that are particularly suitable (shifting the order of the topics according to the interest of the participants. Also, they should be able to attend voluntarily and have the right to reject offers.
- Importance of relationships: it is important to record what people would like to do, their hobbies and ideas, and use social gatherings as a tool.
- Mission statement of the institution: institutions must be aware that persons can be frustrated and fail, and the team of the institution needs to find a common positive position toward digitization, through the establishment of a working group.
- Course design for people with disabilities: it should be based on general educational principles and UDL.
- Information and cooperation: More public relation must be carried out, and it is important to establish a staff unit or a coordinator (e.g., funding opportunities), to network with partners from science and practice to advance the topic further. Also, education should not be offered

only when the situation is already escalating, but on a long-term basis, with workshop topics that can be implemented in larger media projects.

Salmerón et al. (2019) stressed on the importance of positive risk-taking, concerning accessing the internet by persons with intellectual disabilities.

Carers of persons with intellectual disabilities/staff

Caton et al. (2019) investigated the way that carers of persons with intellectual disabilities and/or autism use the internet. They mentioned frequent use of online forums, that gave carers a sense of agency by providing a place to go for. This participation influenced overall perceptions of available emotional and informational support and led to a community of solidarity.

Conclusions

Both persons with intellectual disabilities and their carers/staff should have the digital competences to use ICT. Performing web searches and the use of emailing, social media and YouTube, being able to use bookmarks and cloud storage, and safety concerns (e.g., being able to log in safely after creating an account) are being recurring issues.

It is important to incorporate functional digital literacy skills as part of the curriculum for high school students with ID, whereas in general, face-to-face flexible workshops, based on UDL principles, are better suited for gaining practical skills, both for persons with intellectual disabilities and their carers/staff. The residence of the persons with intellectual disabilities (with family or residential home) is defining to a great extent the kind of opportunities they have to build their digital competences.

Lastly, especially as it concerns the parents of persons with intellectual disabilities, the use of forums is very important, since it allows them not only to gain knowledge, but also receive emotional support.

Research question 5 and results - Relations of persons with intellectual disabilities with social media: an intersectional approach

Various publications that were useful for defining the relations of persons with intellectual disabilities with social media were identified. Literature reviews that described elements of the current status conclusions are presented first. What follows is a narrative description of each of the studies that included human subjects, regarding this question, with brief conclusions, and according to a grouping that stemmed from Caton et al. (2016) systematic review. The last part of this section are the conclusions.

Literature reviews

Caton et al. (2016) investigated the use of social media by persons with intellectual disabilities. After applying thematic analysis on the texts, they identified the nine following themes concerning areas that are important (ordered according to our criteria):

- accessibility/design
- communication and literacy skills
- level of usage
- support
- happiness and enjoyment
- relationships
- social identity
- cyber-language and cyber-etiquette
- safety and safeguarding

Acosta-Vargas et al. (2021) investigated accessibility and mobile applications issues for persons with cognitive, motor, and sensory disabilities, and concluded that studies regarding accessibility for cognitive disability were 9.1% of the total and three of 22 studies were associated with social media use. The exact participation of persons with intellectual disabilities in these studies is not specified. Furthermore, Glencross et al. (2021), in a literature review about internet use by persons with intellectual disabilities, concluded that they would most frequently use social media and social networking (23%).

Also concerning accessibility and design issues, Martins et al. (2021) investigated the needs of, attitudes towards, patterns of use of digital media by individuals with ID, and the guidelines that must be followed when developing accessible digital solutions. They concluded that their opportunity to use social media depends on the platform's prior inquiry into information about their needs, as well as the way that social media use is integrated with the function of other digital media.

Regarding accessibility, as influenced by the type of residence of persons with intellectual disabilities, Bakkum et al. (2022) examined the use and feasibility of information and communication technology for social contact by persons with intellectual disabilities, living specifically in care facilities. It was recorded that these persons use indirect means of communication, meaning that they would receive text messaging and then might respond with voice-call. They would also use social media (mainly Facebook, Instagram), and email, but these would entail less reciprocity with the recipients.

Regarding the age of persons with intellectual disabilities and their relationships, Borgström et al. (2019) analyzed the research findings in the field of young persons with intellectual disabilities and social media. They recorded that usage has increased over the last years, offering an expansion of their social circle, helping them keep in contact with others and express thoughts and opinions in a setting they feel they have more control over, and seek for romantic or sexual relationships. In addition, it is recorded that social media is an "arena for identity formation" (p. 136) that also gives an "opportunity to remain anonymous" (p. 136). Ultimately, online, and offline activities are becoming increasingly interlaced for young persons with intellectual disabilities, who might feel that "they can be like everyone else" (Löfgren-Mårtenson, 2008, as stated in Borgström et al., 2019).

In a study that investigated social media use by persons with communication disabilities who use AAC (some of them can be persons with intellectual disabilities), Hemsley et al. (2017) recorded the need for more research in use of social media data across a bigger range of platforms, including Instagram and YouTube, in order to provide important insights into the lives of persons who use AAC and the ways in which they and their supporters use social media. A focus on safety and cyber-resilience across social media platforms is also important, since these could help to inform development of interventions that enhance individuals who use AAC and their supporters against preventable and harmful social media safety incidents. They could also reduce gatekeeping activities that are now utilized to prevent persons who use AAC from accessing social media in the same way as their peers without disabilities.

Ultimately, Chadwick et al. (2022) investigated the way that COVID-19 pandemic has led to a rapid transfer of everyday activities to the online world, regarding the lives of persons with intellectual disabilities. They recorded that these persons would retrieve COVID-19 information from the internet and social media, although they were not able to access updated and easily understandable COVID-19 information. They also recorded the inequity of access to online supports across all age groups in all areas of life and that the digital divide continues to disproportionately affect persons with intellectual disabilities.

Research including human subjects

The mapping of relations of persons with intellectual disabilities and social media, following an intersectional approach, took into consideration the following parameters:

- age (younger adults – older adults)
- gender (men – women)
- level of ID (mild, moderate, severe)
- employed – not employed
- living with family – living in residential home
- living in rural areas – living in urban areas

Also, the categories following were specified as in Caton et al. (2016).

Accessibility/design

In a study about the way that adults with intellectual and developmental disabilities access the internet, and what correlates with internet usage, Kim et al. (2021) concluded that, amongst others, they use social media to a great extent.

Kjellstrand et al. (2022) recorded that persons with Down's syndrome mostly visited YouTube, administration websites and medical services websites, suggesting that internet is used both for public services and social interactions. Regarding older adults, they would continue to use digital everyday services, such as ATMs, even after they were no longer actively using personal ICT tools, such as mobile devices.

In more study that investigated digital accessibility for persons with intellectual disabilitiesD concerning their communication using social media and examined their perception and the perceptions of their coaches, Daems et al. (2015), concluded that persons with intellectual disabilitiesD have a great interest in social media since these offer a lot of opportunities, yet they also encounter several issues, either concerning the devices being used, or due to the application itself.

In a study that investigated the impact of social media training on the social networks' development of youth with ID living in rural communities of Australia, Raghavendra et al. (2018) revealed the need for use of Dragon Naturally Speaking, a software that translated speech into text.

Communication and literacy skills

Bayor et al. (2019) organized collaborative workshops for young adults with ID, to identify participants' competencies, abilities, and support requirements in social media. One of their conclusions was that, through this participatory approach, participants could develop social media

skills, enhance their participation in social media, and also interact with and support or by supported by their peers. Also, concerning their training, it is important to note that their different preferences and interests should be taken into account when using social media.

In an investigation the experiences of 9 persons with cerebral palsy who used augmentative and alternative communication (AAC) and social media, through their participation in an online focus group, Caron et al. (2016) concluded that successful social media use was important in order to maximize communication for individuals who use AAC and allowed users to interact and communicate rapidly, efficiently, and effectively, anywhere, anytime, with more persons than ever before. The end goal proposed by the authors was not to simply provide technology and access to social media, but rather to maximize communication and participation for individuals with complex communication needs, and that would entail comprehensive interventions.

Internet and multimedia skills can help reduce the some of the limitations of geographical isolation and increase education and employment opportunities for youth with disabilities, and social media sites play a vital role to bridge the communications barriers. A study that investigated the impact of social media training on the social networks of youth with living in rural communities of Australia (Raghavendra et al., 2018) revealed that individualized home-based one-to-one training on digital skills has been effective in improving social media skills.

Ultimately, Koushik et al. (2022) examined the way that smart devices can expand their features to support customized prompts with augmented reality for persons with cognitive disabilities. They recorded that, for those who use other assistive devices, an important parameter is the compatibility of, e.g., the social media platform, with existing assistive technologies and third-party sources.

Level of usage

(Andrew et al.) Holmes and O'Loughlin found that social media offered specifically young women with ID an opportunity to expand and maintain their networks and access to information through content consumption, and that would create opportunities to support independent skills learning development. Also, Kjellstrand et al. (2022) recorded that specifically young persons with Down's syndrome were more likely to make more social and less academic use of ICTs in comparison with other groups, primarily due to a lack of access to ICT tools in learning contexts.

Support

In their study, Koushik et al. (2022) examined the way that smart devices can expand their features to support customized prompts with augmented reality for persons with cognitive disabilities. They recorded that, for those who use other assistive devices, an important parameter is the compatibility of, e.g., the social media platform, with existing assistive technologies and third-party sources.

A study that investigated the impact of social media training on the social networks of youth with living in rural communities of Australia (Raghavendra et al., 2018) highlighted the opinion of caregivers that assistive technologies facilitate access to social media and offers online independence, even if digital skills are not developed enough. For instance, five youths required Dragon Naturally Speaking, a software that translate speech into text.

Happiness and enjoyment

A study by Andrew et al. (2018) regarding four social media sites (Facebook, Instagram, Snapchat, and YouTube) found that YouTube was mentioned as the one that was mostly used. The participants used YouTube to view content as part of their entertainment

Caron et al. (2017) investigated social media experiences of adolescents and young adults with cerebral palsy who used a range of communication media and augmentative and alternative communication to participate in daily interactions, including social media. Participants used social media (amongst others) to support independent leisure (playing games, looking at pictures/videos).

Kaur et al. (2022) described the case of a young man with a physical and learning disability, who felt bullied in mainstream college and excluded in schools for persons with disabilities, by students with disabilities “less visible or obtrusive” (p. 432). This man resorted to a game of virtual farm.

Relationships

A study by Andrew et al. (2018) highlighted the fact that social connectedness offered by Facebook allowed young adults with ID to maintain their connections and relationships with existing friends and family. Also, Alfredsson Ågren et al. (2020) investigated the digital participation of adolescents with and without ID and concluded that adolescents with ID have less contact with friends on social media and usually use phone video calls to contact them.

White et al. (2020) adapted the Social Network Guide (system for measuring the structural, interactional, and supportive aspects of individual’s networks) according to the needs of adolescents (age 14 to 17) with and without ID. They recorded that the use of social media would not increase the size of the social network of the persons and, therefore, suggested individualized training. They also recorded that social media use was predictive of the number of reported friendships, although it was not associated with critical comments.

Caron et al. (2017) investigated social media experiences of adolescents and young adults with cerebral palsy who used a range of communication media and augmentative and alternative communication to participate in daily interactions, including social media. Participants used social

media (amongst others) to bypass the constraints of face-to-face interactions and communicate for a number of reasons (maintain relationships, share experiences).

Internet and multimedia skills can help reduce the some of the limitations of geographical isolation and increase education and employment opportunities for youth with disabilities. Social media sites play a vital role to bridge the communications barriers. A study that investigated the impact of social media training on the social networks of rural youth with living in rural communities of Australia (Raghavendra et al., 2018) revealed that intervention helped to extend social network for the group of youth, who typically have fewer social connections compared to their peers without disabilities.

Social identity

Molin et al. (2015) investigated parents and teachers views on internet and social media usage by students with ID. According to their conclusions, persons from the immediate adult environment have feelings and perceptions that most likely play an important role when supporting young persons with intellectual disabilities in their usage of the internet and social media. Teachers more strongly emphasized a student's use of the internet for interactive purposes. Parents had expectations that the internet could be a tool for gaining more awareness of one's own disability and a way to meet other peer group students. It is important to note that participants of the research were ready to look beyond problematic situations in order to draw upon opportunities to develop and maintain social relations.

Cyber-language and cyber-etiquette

According to Bayor et al. (2018), n-etiquette is a key challenge for social media participation of persons with intellectual disabilities. Training can be harnessed to create awareness to solve issues around the social norms and online n-etiquette challenges that participants faced.

Safety and safeguarding

Chadwick et al. (2019) investigated online risk and cybercrime regarding to persons with intellectual disabilities and social media use. Categories of dangers stemming also from there, are the following:

General dangers

A study that investigated the impact of social media training on the social networks of rural youth with living in rural communities of Australia (Raghavendra et al., 2018) revealed the need they have for intervention to reduce the frustration to make new friends online, while at the same time being hesitant to connect with strangers due to privacy concern.

Sexual exploitation

Caton et al. (2022) examined the vulnerability of young persons with intellectual disabilities concerning internet safety associated with the use of social media. They concluded that students feel confident about online safety and communication with strangers when using instagram, Facebook, or snapchat in their mobile phones, tablets, or computers. They also mentioned that persons with intellectual disabilities would prefer a location where they had privacy. On the other hand, their parents were more concerned and would actually think that even though their children were trained concerning "grooming", when "they're in that moment, it's different" (Caton et al., 2020, p. 93). The perceptions of their teachers also showed hesitancy regarding to their safety, in the absence of adequate training.

Andrew et al. (2018) concluded that YouTube, as long as it is used as a way to view videos, is as safe social media, since it can be accessed (at least for that purpose) without the creation of an account, supporting persons' anonymity and by extension their safety and security. However, some parents and support staffs do not want their adult children with ID to use Facebook due to fear of them being exposed to associated risks. In addition, some participants of the study were exposed to financial fraud from unknown friends, and one of the fears that parents had was that their lack of competences could increase the chance of their children to be victims of online sexual harassment and exploitation in Facebook.

In a study conducted in residential homes, Ramsten et al. (2019) inquired staff perceptions with reference to the role of ICT and how ICT affects the daily life of young adults with mild to moderate ID. Social media were recorded to be "enforcing a balance between social inclusion and social exposure" (p. 174) and at the same time "bringing out the vulnerability in a risky environment" (p. 174).

In a case study concerning the probability that persons with intellectual disabilities could be the perpetrators themselves in an inappropriate online sexualized behaviour, Chandler et al. (2016) recorded the results of cognitive behavioural approaches to treat a gentleman with intellectual disability who had been reported to the police for allegedly making contact with children using social media in an attempt to initiate a romantic relationship. Whilst the gentleman reported becoming "safer" in terms of initiating contact with unknown persons via social media, after 11 sessions, this could not be substantiated according to the evaluation of the professionals and is indicative of the major difficulty of monitoring online recidivism.

Financial exploitation

Andrew et al. (2018) concluded that some participants of their study were exposed to financial fraud from unknown friends.

Conclusions

The most important concepts that are related to social media usage by persons with intellectual disabilities are the following:

- accessibility/design
- communication and literacy skills
- level of usage
- support
- happiness and enjoyment
- relationships
- social identity
- cyber-language and cyber-etiquette
- safety and safeguarding
    - general dangers
    - sexual exploitation
    - financial exploitation

Persons with intellectual disabilities are reported to use digital technology for social media and social networking, to a great extent, and probably because other types of applications are too demanding for them, and they also do much less academic use. Facebook, YouTube, WhatsApp and Snapchat are mostly mentioned, also for entertainment purposes. Nevertheless, they might still find difficulties in using a specific platform or using it in integration with other digital media. Those who live in care facilities use some social media, but in a way that entails less reciprocity. Use of AAC devices is sometimes integrated with their use, as well as voice recognition technology. In addition, the use of other assistive devices should be considered.

Use of social media is an considered as an arena for formation, an opportunity for the person to remain anonymous, and be like everyone else. This entails dangers, as perceived mainly by their parents, but the situation is not the same in all countries. E.g., in United Kingdom, parents are reported to be mostly afraid of the probability that their child will be hurt, due to the intentions of a stranger, and their children's inability to practice what they have learned in terms of safety when it is necessary to do so, even when they are adults. Thus, these parents assume the role of "gate-keeper". On the other hand, in Sweden, parents are reported to be mostly afraid of their child being alone, thus, they have accepted the use of social media by their children to a greater extent.

Nevertheless, COVID-19 conditions have enforced the use of social media in the lives of persons with ID. However, they were not able to access updated and easily understandable COVID-19 information.

Younger adults use social media more often, as do those with mild or moderate level of ID and are employed. Conditions of use might be different, depending on whether the person lives with their family, or in a residential home. Also, persons with intellectual disabilities living in rural areas use social media less.

Concerning their training in social media use, their interests should be considered, as well as peer support.

Social media allow persons with intellectual disabilities to remain connected with people they already know and share experiences with them, and much less to get to know new people. Lack of training in netiquette is a difficulty they often face.

A great issue regarding social media use by persons with intellectual disabilities is the dangers they are considered to be facing more than others, and these can be the general danger of feeling frustrated by their difficulties to use them for the purposes they would wish to do so, sexual exploitation by strangers (mostly feared by their carers and less by them), and even the probability that they may become the perpetrator, without knowing. Lastly, financial dangers are also probable.

Research Question 6 and results - Co-design methodology

Twenty-six publications that were useful for answering the question of co-design methodology in use were identified. Two systematic reviews that describe elements of the current status conclusions are presented first. Then, theoretical work is presented, regarding the creation of corresponding frameworks. What follows is a narrative description of each of the studies that included human subjects, regarding this question, with brief conclusions. The last part of this section is a table with basic information on co-design research including human subjects.

Systematic reviews conclusions

Kjellstrand et al. (2022) conducted a mixed study that included systematic review, administration of online surveys, interviews, and digital workshops. One of their conclusions, deriving from the literature review, was that inclusion and participation are topics that are not discussed in academic literature regarding web accessibility for persons with cognitive disabilities in conjunction with or as much as design considerations are being discussed. As a matter of fact, one fifth of publications identified in our report mention co-design. Indeed, in a systematic literature review regarding the use of digital game-based learning for students with ID, Stancin et al. (2020) recorded that it is important to create a framework of educational games solutions, with the use of design-based research, which is defined as iterative analysis, design, development, and implementation. Nevertheless, they don't mention anything about the importance of the participation of different stakeholders

Theoretical publications

Nguyen et al. (2020), in a publication that promoted the creation of a conceptual framework for key dimensions of digital inclusion in general, attested that "an inclusive approach should be taken in the research and design of digital technologies".

Spencer et al. (2020) considered the inclusion of persons with intellectual disabilities generally in participatory design processes and presented relevant methodological adaptations and supports. They proposed the involvement of an Advisory Panel that included persons with intellectual disabilities and field experts, in four stages:

1. Preparation phase (discovery), which is led by education specialists. During this stage, with the use of easy-to-read material, the project's objectives are agreed, and the team should be immersed in real research scenarios. Also, improvement of problem-solving skills should be encouraged, as well as personal autonomy.
2. Fieldwork phase (definition), which might include field trips. Analogue, digital, or mixed methods can be used, in order to record observations that will be compared with the

observations recorded by the researchers. A meeting for the analysis of the findings is necessary, in order to constitute a phase of co-design and expert validation. User experience is often the center of these discussions.

3. Ideation phase (development) workshop, for alternative solutions ideation. A scenario is created, and a narrative presentation is being prepared. The procedure includes "doing, telling and acting", in co-design workshops. It is recorded that, during those, participants should not be asked to create things "from scratch" and the affordances of the kit pieces of the artifact must be clear to the participants.
4. Validation phase (delivery) of alternative solutions, where easy-to-read material is necessary for the clarification of parameters that are seen as problematic by the persons. User testing and prototype validation follows, with the combination of "finished visual design in paper prototypes", where interrelationship between material and spatial elements is very important.

Lussier-Desrochers et al. (2020) examined the creation of a participatory conception model that could guide the development of technologies intended for the active involvement of persons with intellectual disabilities or ASD. They presented 5 stages concerning the research and development process (Table 17):

Table 17 *Five phases of co-design (adapted from Lussier-Desrochers et al., 2020)*

Phase 1. Preparation	**Phase 2. Solicitation and implementation of logistics**	**Phase 3. Initiation and meeting with participants**	**Phase 4. Collaborative work period**	**Phase 5. Acknowledgement of contribution**
1.1. Determine the participants role	2.1. Recruit participants	3.1. Present a global vision of the project	4.1. Present the goal and the purpose clearly	5.1. Invite participants to the launching of the final product
1.2. Analyze the profile of potential participants	2.2. Prepare the workplace	3.2. Clearly explain the role and expected contribution	4.2. Present the proposed activity and the support modalities adapted to the participants' profile	5.2. Explicitly acknowledge the participants' contribution
1.3. Identify necessary support modalities	2.3. Deploy the supporting materials	3.3. Inform on the mode of acknowledging the contribution	4.3. Present prototypes (optional)	
1.4. Plan the activities and develop the supporting materials		3.4. Obtain the participants' consent	4.4. Ensure that the work climate is conducive to the expression of creativity (minimal	

	stress)
1.5. Train the stakeholders	

Heitplatz et al. (2020, p. 209) analyzed interview material of an already conducted study and presented 10 focal points, regarding the optimal way according to which education programs should be designed to meet the needs of persons with intellectual disabilities, their formal caregivers, and social institutions. These are presented in Table 18.

Table 18 *Design of education programs to meet everyone's need (adapted from Heitplatz et al., 2020, p. 209)*

Design of education programs to meet everyone's needs
1. Create space for an open exchange on attitudes and topics related to digitization. Provide opportunities to gain personal experience.
2. Reflect on institutional ideals and discuss the place the digitization should take in the facility. Improve the mission statement
3. Ask employees for their opinion and take fears and wishes seriously to raise acceptance.
4. Each person should be informed about digital topics to establish possible cooperation.
5. Work must be done within inclusive groups or tandems on specific topics.
6. Use UDL to derive practical operation criteria for inclusive education programs.
7. Take into consideration the topics and wishes of the participants.
8. Orientate on modular structures in terms of topic, content, and organization
9. Build relationships to understand the participant's and individual needs.
10. Treat persons with disabilities like everyone else.

Human subjects research

Four levels of co-design were identified in research including human subjects, thus, relevant information from them is presented within groups for each level:

- 1st: acknowledging the importance of co-design
- 2nd: consultation (opinions and ideas without actions on behalf of other stakeholders)
- 3rd: co-design (including actions on behalf of other stakeholders)
- 4th: co-production (working on a new prototype)

It needs to be emphasized that the ranking above is subjective and only preliminary, within the work of this review.

1st level of co-design

There is only an acknowledgement of the importance of co-design, without explicitly using it in research.

2nd level of co-design

Transportation

Alanazi et al. (2022) don't name their study as following a participatory approach. Nevertheless, they included in their research design focus groups with persons with intellectual disabilities, in order to be informed about their perceptions and experiences concerning the use of smartphone applications for transportation and the extent to which these applications improve their mobility.

3rd level of co-design

Accessibility

Buehler et al. (2016) investigated accessibility barriers to online post-secondary education for 6 students (young adults) with ID in a 3D modeling and printing class, 3 interns (with ID) of a lab, and other young adults with ID that another researcher has constant contact with. The students had the chance to use a number of techniques and technologies, concerning information retrieval, navigation and information architecture file management, and password management. During these sessions (to a great extent including observation), researchers had direct interactions with the students and received feedback from them. The authors concluded that students revealed a variety of personal abilities and needs, thus, they claim that there is a strong need for participatory research.

Communication – social inclusion

Gibson et al. (2020) investigated the process of designing a tablet application along with the use of AAC technologies, in order to promote communication between patients with mild ID and their general practitioners. The persons with intellectual disabilities participated in workshops and were (beforehand) provided with easy-to-read information organized in a sheet. Data were collected through focus groups.

Education

Figueredo de Santana et al. (2016) examined the challenges and opportunities in computer-based vocational training for low-income communities of 23 persons with intellectual disabilities, through observation and semi-structured interviews. Also, Guimarães et al. (2016) investigated instructional pacing supports for teaching students with ID. In these classes, there were 11 participants with ID, who used the educational platform that had been created by the researchers. The authors concluded that technology could help the instructor to control the pace of the class, but it also posed barriers to the development of students' autonomy and self-esteem.

Augmented/ virtual reality

Sitbon et al. (2016) examined the design of embedded virtual reality content into life skills training for persons with intellectual disabilities. The co-design process was conducted over several iterations by teams of university students, project leaders from a support organization (acting as proxies), and several persons with intellectual disabilities.

3D printing

Buehler et al. (2015) investigated the use of 3D printing for integrated classrooms. For that scope, they interviewed 7 mainstream educators with experience in teaching 3D modeling and printing, to gather teaching strategies and technical recommendations for implementing a 3D printing classroom. These interviews gave the basis for the technical tools necessary to implement 3D printing courses for persons with intellectual disabilities.

4th level of co-design

Accessibility

Seatjata et al. (2018) investigated the co-design process for a transport application for persons with intellectual disabilities. The result of their work was a table that includes initial design criteria, based on the universal design and accessibility guidelines, and more specifically on drawing upon lessons from existing research through literature review. The study identified lessons from the first stage of the participatory and iterative design of a transport application that would have improved accessibility features. The conclusion after the co-design process was suggestions about future improvements, mainly around audio feedback given to participants (Table 12). Also, Zhang et al. (2016) examined the design of a novel solution that would offer independent accessibility for persons with intellectual disabilities who have difficulties in typing. They used NFC equipped tokens, cards or small 3D objects, as physical handles to online resources. Secondly, they used NFC tokens to store frequently used key words and serve as visual aids to enable query through combination of tokens without typing at all. The authors considered that this development opens up the opportunities for co-design between persons with disability and caregivers, customized services, and collaborative support for diverse users via online volunteers.

The initial design criteria for the prototype are presented in Table 19. Most of the design criteria depend heavily upon the subjective experience of end users, whereas elements of the initial prototype sought to respond to these criteria.

Table 19 *Design criteria and initial design response regarding a transport application (adapted from Seatjata et al., 2018)*

Design criteria	**Initial design response**

Easy to access	easy to navigate throughout the application
Simplicity	one function per screen
Readable text	plain English text large fonts
Alternative to text	audio output text-to-speech images
Clear organization	instructions buttons clear display
Elimination of fear of getting lost	error message progress bar
User control – Provision of personalized options (DC07)	navigation system creation of own journey
Elimination of fear of poor memory skills	alarm system
Management of fear of unfamiliar environment	unbroken trip emergency contact

McDonald et al. (2022) studied the identification of strategies that could lead to the facilitation of inclusion of adults with ID as direct respondents in research. The research involved an Expert Panel that included adults with ID, family members and close friends, disability service providers, researchers, and Institutional Review Board members. Individual interviews and focus groups were conducted, with each of the stakeholders, in a multi-phased process. A self-report survey with two parallel forms (one for adults with ID and one for the other four stakeholders) was created.

Sitbon et al. (2020) examined the perspective of a design that is ability-based and participatory, in order to increase the involvement and engagement of persons with intellectual disabilities in interactive information retrieval research. Their tool was a search application for videos, to assist persons with intellectual disabilities to learn (in an online module) life skills that they considered important. In their research, they included (amongst others) interviews and feedback sessions with experts in supporting persons with intellectual disabilities. Concerning the participation of persons with intellectual disabilities themselves, use of surveys or interviews was considered “like a test” and was not preferred. Instead, the Reflective Agile Iterative Design (RAID) framework was used, that led

to the organization of group sessions and technology workshops, with “training about and co-exploration using social media, together, in the spirit of reciprocity”. During the procedure of the workshops, persons’ competences were revealed. Also, competences put into focus were those that were representative, meaning practically executed. Thus, competences were also enhanced (and not only “studied”), through, e.g., the creation of shared accounts. Lastly, during the workshops, the assistance of staff and caretakers was also utilized.

Transportation

Khan et al. (2021) worked towards designing a mobile application for independent travelling of young adults with Down's syndrome, with an examination of barriers being faced. They used collaborative participatory action research in three cycles:

1. Identifying the problems: semi-structured interviews with parents and an online survey with persons with Down syndrome and their parents. Focus groups were not used at this stage due to the parents’ schedule.
2. Action (solution) planning: focus groups with parents and young adults with Down syndrome, to gain deeper insights.
3. Action taking and reflection: design of a digital prototype of the application, according to participants’ recommendations and conduct of focus group meetings with caregivers and individuals with Down syndrome.

In this study, writers considered imperative the conduct of separate interviews of persons with Down syndrome and their parents, in the beginning of the study, to make sure that the focus is on the perceptions and needs of the persons. Later, joint discussions took place, and the two stakeholders were involved together in co-design. Parents can be very helpful in making their children’s needs more understandable to persons who don’t know them.

Sitbon et al. (2019) presented the lessons learned from a participatory design process that focused on understanding the engagement and preferences of users with ID viewing 360° videos. They researchers used an iterative ethnographic design process that included discussing requirements and questions, designing videos, and presenting videos for verbal and behavioral feedback. Each trial was conducted one-on-one with participants. During these trials, often, other participants were present in the room, as well as one or two support workers. The role of support workers was dual: to facilitate the trial and reframe questions from the research team where appropriate, and to provide insight into meaningful behaviour of participants, since they were well known to participants. The roles of the researchers (at least two during every trial) were to facilitate, record, and provide technical support for the sessions.

Communication – social inclusion

Wilson et al. (2016) developed a mobile application that would support the communication, interests and goals of persons with intellectual disabilities. 30 young adults with ID were enabled to produce an image of themselves, in order to achieve a certain goal, either in a formal environment, or for taking "group selfies", or emailing their images to proxies, to enhance overall communication, self-expression, and socialization. There were participant-driven prototype trials that led the authors in the conclusion that the part of designers and proxies must be replaced by true participatory design motivations, whereby the individuals are central to the design process.

Martin et al. (2021) investigated the specific aspects of mobile devices and applications that are associated with the social inclusion of persons with intellectual disabilities, as well as the background attributes that were associated with particular patterns their use and persons' social inclusion. They attest to have used inclusive research design (participatory and advisory approach), since one of the chief investigators was a coresearcher with intellectual disabilities and they used an advisory group, to develop the research tool and pilot it in four stages, to check clarity, comprehension, and length of completion.

E-health applications

Lazar et al. (2018) conducted research on co-design process involving persons with Down syndrome, with an emphasis on the involvement of their parents and caregivers. The result of a focus group with three cycles of co-design workshops for the design of a smartphone application that helps them manage their nutritional habits revealed that end user's independence was a common issue discussed. Families emphasized on tools that help persons with Down syndrome to access digital media when their care givers are not present, and also highlighted the importance of auditory and visual features of applications, to increase user engagement. The visual strength of persons with Down syndrome was documented over the period of co-design workshops to use as main visual cues in both the development (use of storyboard) and actual interface design, ensuring the accessibility of the application. On the other hand, Torrado et al. (2020) examined the development of an android exercise game that intended to motivate persons with intellectual disabilities to exercise physical activity outdoors, by walking, while having a gamified experience. They researchers called their design "interaction design" and they investigated the important factors of designing a navigational assistance system. Initially, they conducted semi-structured interviews with health care workers and a focus group with therapists and software engineers. Afterwards, they conducted a preliminary user test with users with ID and their caregivers. Lastly, unstructured observations and group interviews were conducted, to further refine the prototype of the application. In this study, various stakeholders

assisted in the implementation of this research, with the persons with intellectual disabilities entering the research at a later stage, when some information had already been defined.

Augmented/ virtual reality

Iatraki et al. (2021) included in their study one person with ID, an 18-year-old student who evaluated the design of a system that could assist in the creation of digital learning environments that contribute to Science Education. This contribution was implemented through the use of augmentative and virtual reality, whereas teachers and researchers also participated in the evaluation of the system, through the conduct of focus group with semi-structured interviews. Also, Koushik et al. (2022) used a remote (virtual) participatory-collaborative design approach to understand how smart devices can expand their features to support customized prompts with augmented reality for person with cognitive disabilities. They used semi-structured interviews and a virtual design activity (with the participation of parents) to sketch prompts for multiple scenarios in three daily tasks. Lastly, they conducted a discussion about benefits and concerns of adopting an augmented-reality-based smart display.

Other

Senaratne et al. (2022) investigated the design, development, and evaluation of a curated set of accessible electronic modules, by adults with ID. They concluded that “design attempts for minimizing errors and failures should not eliminate room for skill improvement”. They also underscored the need to “design for small wins” and lastly, they emphasized on the importance of the presence of more than one “evaluator” during the procedures, so that the reactions of the persons with intellectual disabilities are better interpreted.

Conclusions

Concerning research that included the participation of human subjects, the different stakeholders that participated could be:

- persons with intellectual disabilities
- students without ID
- parents
- family members
- caregivers
- support workers
- project leaders
- therapists
- software engineers

- other researchers
- other professionals (e.g., taxi drivers)

Regarding the type of co-design methods and strategies used, these included (in order of increased level of participation):

- acknowledging the importance of participatory research (without already implementing as much as deemed important)
- observation and discussion
- workshops
- interviews
- focus groups
- use of storyboard
- advisory board

The procedure is often described as iterative, in some cases with different cycles of workshops Nevertheless, persons with intellectual disabilities might not participate in all (the initial) stages of research and enter at a later stage. Also, when stages include the participation of caregivers for the recording of their perceptions, an initial stage with separate interviews of persons with intellectual disabilities is deemed important, to emphasize the person-centeredness of the process. Due to the circumstances in organizations where research is conducted, other persons, not directly participating in the research, might be present and influence the course of the research, by participating in it in a way. This is not considered necessarily negative and can indeed invigorate the research process. One research included a person with ID with the role of co-researcher, with their name being acknowledged in the information concerning the authors of the research. In addition, other researchers conducted the investigation of a virtual (taking place remotely) participatory-collaborative design, meeting the needs of a post-pandemic era of research conduct.

Basic information from each of the studies that included the use of human objects is included in Table 20, regarding co-design approach. Studies are presented in alphabetical order, according to the name of the first author.

Table 20 *Co-design approach in research with human subjects*

Authors	Topic	Involvement of different stakeholders	Strategies used	Level of co-design	Other information
Alanazi et al. (2022)	transportation app (taxi)	persons with intellectual disabilities	focus groups	2nd	inclusion of taxi-drivers in future research
Sitbon et al. (2016)	embedded virtual reality content for life skills training	• persons with intellectual disabilities • university students • project leaders from support organizations	focus groups	3rd	none
Buehler et al. (2015)	3D printing	mainstream educators	interviews	3rd	none
Buehler et al. (2016)	accessibility barriers	students	• observation • discussion	3rd	none
Figueredo de Santana et al. (2016)	computer-based vocational training	persons with intellectual disabilities	• observation • semi-structured interviews	3rd	none
Gibson et al. (2020)	tablet application for use with AAC technologies	persons with intellectual disabilities	• easy-to-read information • workshops • focus groups	3rd	none

Authors	Topic	Involvement of different stakeholders	Strategies used	Level of co-design	Other information
Guimarães et al. (2016)	educational platform for instructional pacing supports	persons with intellectual disabilities	not specified	3rd	none
Iatraki et al. (2021)	augmentative and virtual reality	• person with ID • teachers • researchers	focus group with semi-structured interviews	4th	none
Khan et al. (2021)	independent travelling	• persons with Down syndrome • parents and caregivers	• semi-structured interviews with parents • online survey with parents and persons with Down syndrome • focus groups	4th	separate interviews of persons with intellectual disabilities and parents in the beginning of the study
Koushik et al. (2022)	augmented reality customized prompt for daily tasks	• persons with intellectual disabilities • parents	• semi-structured interviews • virtual activity • discussion	4th	virtual participatory-collaborative design
Lazar et al. (2018)	management of nutritional habits	• persons with Down syndrome • parents and caregivers	• three cycles of workshops • storyboard	4th	none

Authors	Topic	Involvement of different stakeholders	Strategies used	Level of co-design	Other information
Martin et al. (2021)	aspects of mobile devices and applications that are associated with the social inclusion of persons with intellectual disabilities (development of a tool)	persons with intellectual disabilities	piloting in four stages	4th	• one of the chief investigators was a person with ID • advisory group (development of the tool)
McDonald et al. (2022)	inclusion of adults with ID as direct respondents in (online) research (development of self-report survey)	persons with intellectual disabilities • family members • close friends • disability service providers • researchers • Institutional Review Board members	interviews focus groups	4th	expert panel
Seatjata et al. (2018)	transport application (accessibility features)	persons with intellectual disabilities	not specified	4th	none
Senaratne et al. (2022)	curated set of accessible electronic modules	persons with intellectual disabilities	not specified	4th	none
Sitbon et al. (2019)	viewing 360° videos	persons with intellectual disabilities	trials	4th	need for presence of more than one

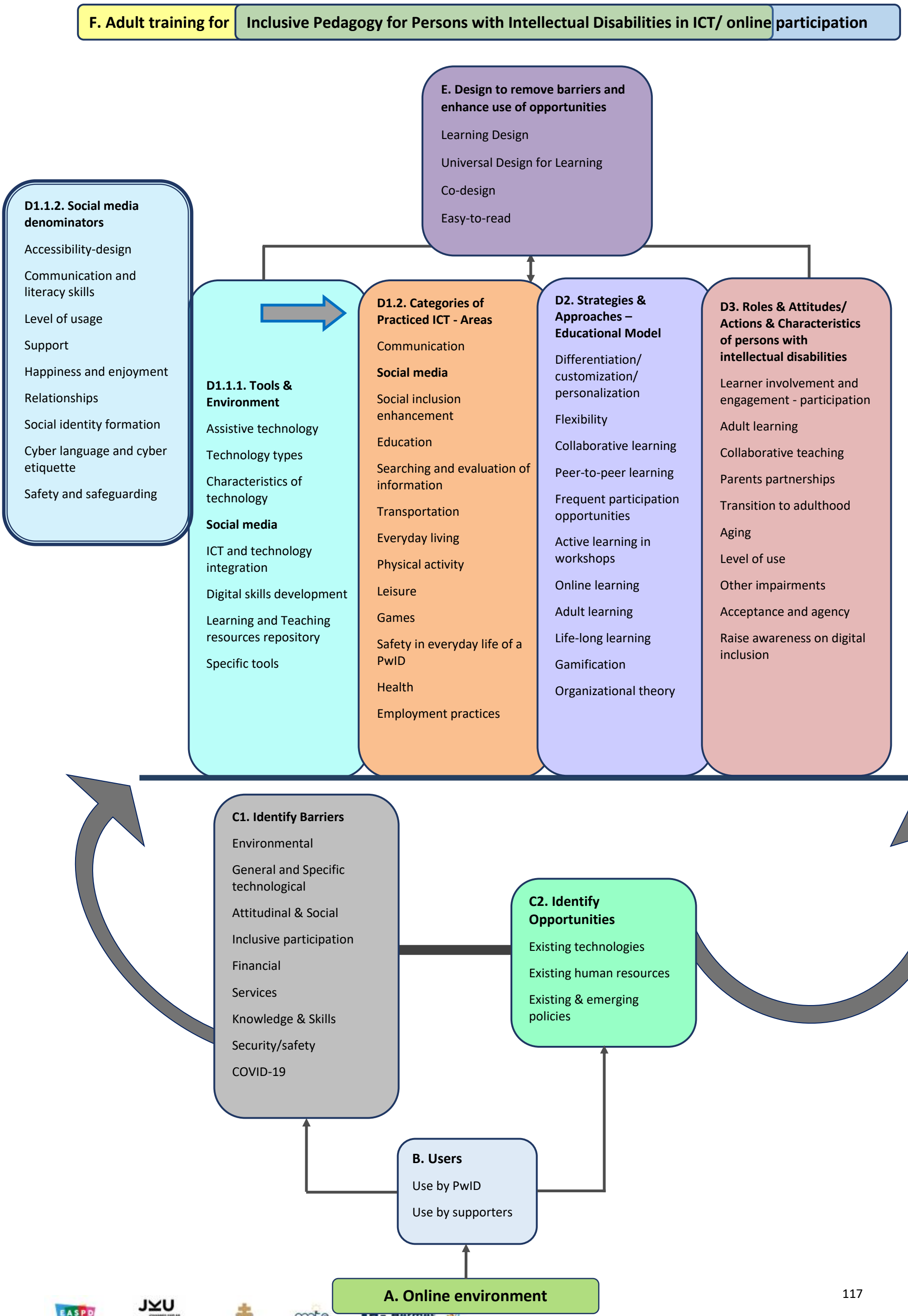
Authors	Topic	Involvement of different stakeholders	Strategies used	Level of co-design	Other information
		support workers			"evaluator"
Sitbon et al. (2020)	Interactive information retrieval search of videos for online learning of skills	persons with intellectual disabilities caretakers staff supporters	interviews feedback sessions workshops	4th	Reflective Agile Iterative Design (RAID) framework
Torrado et al. (2020)	android exercise game (navigational assistance)	• health care workers • therapists • software engineers	• semi-structured interviews • user test • unstructured observations • group interviews	4th	"interaction design"
Wilson et al. (2016)	mobile application for the support of communication, interests and goals	persons with intellectual disabilities	prototype trials	4th	none
Zhang et al. (2016)	independent accessibility with NFC equipped tokens, cards or small 3D objects	persons with intellectual disabilities	not known	4th	none

Research Question 7 and results - Methodological Framework of the project

The aim of the literature review was to inform the next phases of the project, by providing a detailed insight of the state of the art and existing knowledge on the digital competences and digital inclusion of people with intellectual disabilities. This information is collectively outlined in a methodological framework drawn upon the main concerns in terms of barriers, opportunities, technologies, and the human aspect involved in promoting digital competences and inclusion for persons with intellectual disabilities, their families and the teams they are collaborating with.

A systematic approach was adopted to inform the methodology framework of the project, by outlining existing practices and opportunities, activities and tools, barriers, and the matching of technology with learners and contexts. That was important, in order to structure and understand the next steps of the project, regarding use of online ICT for persons with intellectual disabilities. The framework is presented below in two different levels of analysis: The first is presented in a synoptic diagram (Figure 15), and the second (which is more comprehensive) is presented bulleted, with headings and subheadings to guide the reader through the diagram. The logic behind the classification framework for ICT-based learning technologies for persons with disabilities by Hersh (2017) was very useful for the formulation and presentation of our methodological framework, covering of course the needs of RTCN project.

Figure 15 *"Right To Connect Now" Methodological Framework*



Comprehensive description of the methodology

The description of the methodological framework has a bottom-up approach. Start reading from bottom (Online environment) to progressively leading to the Aim: Adult training for Inclusive Pedagogy for Persons with Intellectual Disabilities in ICT/ online participation.

A. Online environment

Element A is the starting point for achieving the aims of the project. In this project the environment of activity and interaction is identified as the online environment, which can be accessed from:

- A family home.
- A residential home.
- A home where a person with intellectual disabilities resides with a friend or a partner.
- An organization where the person with intellectual disabilities receives services.
- A workplace.
- Commuting from one environment to another.

Of course, a combination of an organization or a workplace and a type of home is possible.

B. Users

The second element in the framework is the user of technology (and probably the online environment), who maybe be:

- The persons with disability themselves.
- An assistant. Regarding the assistants, when these are members of the staff, professional and practical knowledge should be enhanced with adequate modules of learning.

C1. Identify barriers

Element C refers to barriers and opportunities that need to be identified in order to remove barriers and exploit opportunities towards the main aim of the project. In order for a person with intellectual disabilities to be supported in the use of ICT (including online digital technologies), barriers should be identified, as well as factors that might lead to failure. These barriers and factors include:

- Environmental factors: Access should be feasible in all contexts, and training might take place in a number of these contexts, including commuting from one context to another.
- General and Specific technological parameters of the system: These should follow COGA guidelines, and also technical and functional requirements. Regarding COGA guidelines, these assist the user to:
    - Understand what things are and how to use them.
    - Find what they need.
    - Have available clear and understandable content.
    - Avoid mistakes and know how to correct them.

- Focus.
- Not need to rely on memory.
- Have help and support.
- Have support adaptation and personalization.

- Attitudinal & Social: The use of dedicated assistive devices might be stigmatized by other people. Awareness is essential to remove stigmatization and prejudice. Also, stakeholders like companies that create their websites don't always take into consideration the needs of persons with intellectual disabilities.
- Inclusive participation: Not all interested stakeholders are included in the procedure of design, training or access (e.g., designers, self-advocates, all carers).
- Financial: The price of some devices or services might be too expensive when not reimbursed by the central or local state.
- Services related factors: Not all services are always available, including assessment, training in use, and support for sustained use, especially during transition periods (to adulthood, to work).
- Knowledge & Skills: Not all aspects of knowledge and skills required are always taken into consideration (technical and cognitive knowledge, emotional parameters).
- Security/safety: Technical issues of safety are not always tackled with.
- COVID-19 and emergency situations: The COVID-19 pandemic has exacerbated a number of already existing barriers. Similar results are observed in other emergency situations such as zones of conflicts.

C2. Identify opportunities

Opportunities should also be identified as they are essential starting point for exploiting existing resources and developing new ones. Opportunities can include the following:

- Existing technologies: Devices that can be on loan, or provided by siblings, peers, friends.
- Existing human resources: A group of pioneers in each organization might lead the education of other staff.
- Existing & emerging policies: The mission statement of the organization should include these issues if they are to tackle with them.

D1.1.1. Tools and Environment

An important element of the framework is the Tools and the Technological Environment(s) in which these are used. In developing the platform and relevant tools in the project we need to take into account:

- Assistive technology: Considering both high-tech and low-tech solutions is helpful.

- Range of Technologies: All technologies can be used and adapted, if designed, developed, implemented in accessible manner. These may include both hardware and software:
    - Mobile technologies
    - Touch devices
    - TUIs
    - Speech recognition
    - Screen readers
    - Eye-tracking
    - AAC (Augmentative and Alternative Communication)
    - AT (Assistive Technology)
    - **Social media***
        - Facebook
        - YouTube
        - WhatsApp
        - Instagram
        - Snapchat
    - Google Maps
    - Serious Gaming
    - 3D gaming
    - 3D printing
    - Extended reality technologies
        - VR (Virtual Reality)
        - AR (Augmented Reality)
    - NFC (Near Field Communication)
    - Digital services
        - ATM use
        - Web-banking
- Characteristics of technology derived from categories of technology, are the following:
    - General digital accessibility
    - Input methods
    - Searching accessibility
    - Safety

D1.2. Categories or Practiced ICT – Areas

Another important element of the framework, is the categories of practiced ICT, that (to some extent) correspond to areas of life:

- Communication
- Social media
- Social inclusion enhancement
- Education
- Searching and evaluation of information
- Transportation
- Everyday living
- Physical activity
- Leisure
- Games
- Safety in everyday life of a PwID
- Health
- Employment practices

D2. Strategies & Approaches – Educational Model

Strategies and approaches used e.g., by trainers are very important and correspond to an educational model:

- Differentiation/ customization/ personalization
- Flexibility
- Collaborative learning
- Peer-to-peer learning
- Frequent participation opportunities
- Active learning in workshops
- Online learning
- Adult learning
- Life-long learning
- Gamification
- Organizational theory

D3. Roles & Attitudes/ Actions & Characteristics of PwID

The roles and attitudes that all stakeholders hold and actions they take, as well as characteristics of persons with intellectual disabilities, are very important when considering engagement with processes regarding digital inclusion of these persons.

- Learner involvement and engagement - participation
- Adult learning
- Collaborative teaching

- Parents partnerships
- Transition to adulthood
- Aging
- Level of use
- Other impairments
- Acceptance and agency
- Raise awareness on digital inclusion

E. Design to remove barriers and enhance use of opportunities

In order to make all the parameters mentioned above work together, a specific design is nevessary:

- Learning Design
- Universal Design for Learning
- Co-design
- Easy-to-read

F. Adult training for Inclusive Pedagogy for Persons with Intellectual Disabilities in ICT/ online participation

This is the ultimate goal of Right To Connect Now project.

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Annexes

Annex A - Application of limiters in the second query

Choice from Source types (77,068)	
Academic Journals	75,204
eBooks	506
Conference Materials	176
Reports	65
Reviews	21
Dissertations/Theses	1
Results 2	**75,918**

Choice from Subject (75,918)	
education	3,466
social media	2,856
covid-19	2,324
internet	1,542
covid-19 pandemic	1,512
communication	1,067
online education	1,002
educational technology	943
youth	929
curriculum	925
technology	872
social networks	828
young adults	798
teaching methods	694
self-efficacy	665
quality of life	655
adults	635
digital technology	608
teaching	592
literacy	571
cyberbullying	549
training	544
distance education	468
teacher education	434
research-article	429

Choice from Subject (75,918)	
Results 3	19,854

Choice from Publication (19,854)	
plos one	674
sustainability (2071-1050)	404
frontiers in psychology	244
education & information technologies	191
british journal of educational technology	149
education sciences	115
international journal of communication (19328036)	88
new media & society	84
journal of autism & developmental disorders	75
techtrends: linking research & practice to improve learning	75
canadian journal of education	68
knowledge quest	68
distance learning	67
educational technology research & development	67
international journal of educational technology in higher education	57
journal of teacher education	54
journal of computer assisted learning	48
aac: augmentative & alternative communication	47
journal of enabling technologies	47
education and information technologies: the official journal of the ifip technical committee on education	44
journal of autism and developmental disorders	39
media and communication	39
adult learning	38
journal of adolescent & adult literacy	38
quarterly review of distance education	35

Choice from Publication (19,854)	
internet research	34
behaviour & information technology	33
educational media international	32
international journal of language & communication disorders	32
science scope	30
information technology & persons	28
online information review	28
australian journal of language and literacy education	25
techtrends: linking research and practice to improve learninga publication of the association for educational communications & technology	25
international journal of speech-language pathology	24
contemporary educational technology	21
electronic journal of e-learning	20
journal of vocational rehabilitation	20
open journal of occupational therapy (ojot)	20
american journal of speech-language pathology	19
education next	16
journal of youth and adolescence	16
learning landscapes	15
research in learning technology	15
interactive technology and smart education	14
communication teacher	12
the learning assistance review	11
computers in human behavior	11
journal of applied communication research	10
journal of behavioral education	10

Choice from Publication (19,854)	
communication monographs	8
radical teacher	8
triplec (cognition, communication, co-operation): open access journal for a global sustainable information society	8
australian journal of adult learning	7
ritish review of sociology	6
disability & rehabilitation: assistive technology	6
nordicom review: ritis research on media and communication	6
ritish journal of educational psychology	4
ritish journal of learning disabilities	4
international journal of stem education	4
nature human behaviour	4
telecommunications policy	4
bulletin of the world health organization	3
igi global	3
journal of entrepreneurship education	3
educational technology research and development	2
iafor journal of education	2
international journal of distance education technologies	2
international journal of information and communication technology education	2
internet & higher education	2
journal of global information management	2
computers and education open	1
journal of adolescent and adult literacy	1
journal of organizational culture, communications and conflict	1
journal of social studies	1

Choice from Publication (19,854)	
research	
social sciences	1
teaching and teacher education	1
the journal of social studies research	1
Results 4	**3,488**

Choice from Publisher (3,488)	
public library of science	651
mdpi	517
springer nature	462
wiley-blackwell	273
frontiers media s.a.	244
taylor & francis ltd	193
emerald publishing limited	117
springer us	93
university of southern california, usc annenberg press	88
sage publications, ltd.	84
information age publishing, inc.	48
information age publishing	44
canadian society for the study of education	35
cogitatio press	39
springer	28
american association for adult and continuing education	38
corwin press, inc.	38
academic conferences international	19
contemporary educational technology	19
open journal of occupational therapy	19
project innovation (alabama)	25
sage publications inc.	16
kluwer academic/plenum publishers	15
springer international publishing	15
learn	14
association for learning	13

Choice from Publisher (3,488)	
technology information society science	12
american speech-language-hearing association	11
elsevier b.v.	9
center for critical education of new york	8
hoover institution press	8
national college learning center association	8
igi global	6
international academic forum (iafor)	6
nordicom, university of gothenburg	6
center for critical education of new york state (cce of ny)	5
jordan whitney enterprises, inc.	4
springer nature publishing	4
education next institute	3
elsevier ltd	3
emerald group publishing limited	3
world health organization	3
canadian sociological association	2
pergamon press - an imprint of elsevier science	2
elsevier	1
elsevier inc.	1
international society for the social studies	1
mdpi ag	1
springeropen	1
international academic forum	1
wiley subscription services, inc.	1
wiley-blackwell publishing ltd	1
Results 5 (final)	**3,382**

Annex B - Mapping of ETS critical components

Authors	Topic	Concepts	ETS	Verbs emerging
Acosta-Vargas et al. (2021)	Investigation of mobile applications and accessibility issues for persons with cognitive, motor, and sensory disabilities.	digital accessibility	access	
Alanazi (2022)	Investigation of the benefits and barriers concerning the use of smartphone applications for transportation by persons with intellectual disabilities.	transportation, safety	access	keep safe
Alfredsson Ågren et al. (2020a)	Digital participation of adolescents with ID (including control group).	digital participation	access	keep safe
Alfredsson Ågren et al. (2020b)	Exploration and description of access to the internet and its usage among adolescents and young adults with mild and moderate ID in their everyday settings.	daily living	access	
Anrijs et al. (2022)	Examination of within-group differences in internet use aspects among persons with intellectual disabilities, asking the persons themselves and not proxies.	digital accessibility	access	
Arachchi et al. (2021)	Exploration of the way that young adults with ID, who had not previously used the internet, interacted with Google search, while enhancing their web search abilities.	search accessibility	access	
Arun & Jain (2022)	Report on independent use of smartphones by persons with developmental disabilities, and benefits	education	access, manage, integrate	

Authors	Topic	Concepts	ETS	Verbs emerging
	from online teaching, worksheets, and videos.			
Bailey et al. (2021)	Investigation of virtual reality and augmented reality communication interventions for children, adolescents, and adults with communication disability and neurodevelopmental disorders.	VR, communication	access	communicate
Bakkum et al. (2022)	Examination of the scientific evidence of the use and feasibility of information and communication technology (ICT) for social contact by persons with intellectual disabilities living in care facilities, and potential effects on well-being.	social media, social inclusion, care facilities	access, manage, evaluate, create	communicate
Balandin et al. (2015)	Teachers' perceptions of virtual worlds as a medium for social inclusion for adults with ID.	gaming, social inclusion	access	play
Balasuriya et al. (2018)	Use of voice activated interfaces by persons with intellectual disabilities.	speech recognition	access, manage	
Balasuriya et al. (2021)	Observation and understanding of the diversity of abilities and preferences of persons with intellectual disabilities when obtaining information from web pages that had been automatically summarized, or full-length standard web pages.	easy-to-read	access, manage	want
Barlott et al. (2020)	Investigation of the experiences of persons with intellectual disabilities using	communication, social inclusion	access	communicate

Authors	Topic	Concepts	ETS	Verbs emerging
	information and communication technologies and the ways these technologies foster social connectedness.			
Bayor et al. (2018a)	Characterization of participation across social media sites (Facebook, YouTube, Instagram, and Snapchat) amongst young adults with ID.	social media	access, create	communicate, keep safe
Bayor et al. (2018b)	Co-designing with young adults with intellectual disability to develop social life skills.	co-design, social media, social inclusion	access, create	communicate
Becht et al. (2020)	Exploration of access to and progress in college academics for students with ID enrolled in inclusive postsecondary education programs.	digital accessibility, education	access	
Bircanin et al. (2021)	Exploration of engagement issues for including adults with severe ID in co-design through active support.	co-design	access	communicate, support-ed
Bonilla del Río et al. (2022)	The way that the use of social networks allows persons with Down syndrome to take part in the digital environment, make their interests visible and interact with audience/followers.	social media, social inclusion,	create	communicate
Boot et al. (2019)	Investigation of the barriers and facilitators that persons with intellectual disabilities faced to effectively access and continuously use essential assistive products.	AT	access	

Authors	Topic	Concepts	ETS	Verbs emerging
Borgström et al. (2019)	Identification and analysis of the research findings in the field of young persons with intellectual disabilities and social media.	social media		communicate
Borgström, Å. (2022)	Identification of gaps related to the challenges of informed consent, providing written information, access to internet arenas and using stimulus materials, concerning young persons with intellectual disabilities.	digital accessibility	access	
Brosnan et al. (2017)	Autism, neurodiverse populations and technology.	social media, AAC, communication, co-design	create	communicate
Browne et al. (2016)	A rights-based conceptual framework for the social inclusion of children and young persons with intellectual disabilities.	social inclusion		
Buehler et al. (2015)	3D Printing for integrated classrooms.	3D printing, social inclusion	access, manage, integrate	
Buehler et al. (2016)	Accessibility barriers to online post-secondary education for young adults with ID.	education	access, manage	
Buijs et al. (2017	Exploration of internet safety issues for adolescents and adults with ID.	safety	evaluate	keep safe

Authors	Topic	Concepts	ETS	Verbs emerging
Caron et al. (2016)	Experiences of adults with cerebral palsy who use augmentative and alternative communication and social media.	social media, AAC	access	communicate
Caron et al. (2017)	Social media experiences of adolescents and young adults with cerebral palsy who use augmentative and alternative communication.	social media, AAC, digital skills, linguistic, operational and strategic competence	access	communicate
Caton & Landman, (2022)	Internet safety for persons with intellectual disabilities (cyberbullying, financial and sexual exploitation, unwanted messages for persons with intellectual disabilities, terrorism)	social media, safety	manage, evaluate	keep safe
Caton et al. (2016)	Use of social media and persons with intellectual disabilities.	social media, safety	access	communicate, keep safe
Caton et al. (2019)	An investigation regarding on carers of persons with intellectual disabilities and/or autism using the internet.	carers, digital accessibility,	access	support
Chadwick et al. (2017)	Internet use and self-ratings for persons with intellectual disabilities regarding the risks and benefits of internet access and use.	safety	access	keep safe
Chadwick et al. (2022)	Investigation regarding how COVID-19 pandemic has meant a rapid transfer of everyday activities to the online world, affecting the lives of persons with	digitalization, COVID-19	access	

Authors	Topic	Concepts	ETS	Verbs emerging
	intellectual disabilities.			
Chadwick, (2019)	Summarization, synthesis, and critical evaluation of the current state of empirical knowledge pertaining to online risk and cybercrime relating to persons with intellectual disabilities.	safety	evaluate	keep safe
Chandler et al. (2016)	Treatment of online inappropriate sexualized behavior.	person with ID as the perpetrator		keep safe
Chang et al. (2021)	The creation of a tangible design framework for practitioners to follow when designing an online social media platform for persons with intellectual disabilities.	social media, co-design,	create	communicate
Chicano et al. (2017)	Presentation of an ICT tool (EC++ mobile application and academic portal) to support professionals in facilitating the inclusion of persons with severe intellectual or developmental disabilities in their communities.	software development	access, manage, integrate, evaluate, create	
Chiner et al. (2017a)	Investigation of caregivers' concerns, prevention strategies and training needs, regarding internet and persons with intellectual disabilities	safety	access	keep safe
Chiner et al. (2017b)	The view of internet users with ID and their caregivers regarding internet use, risks, and online behaviour.	safety, positive risk taking		keep safe

Authors	Topic	Concepts	ETS	Verbs emerging
Chiner et al. (2017c)	Internet use, risks and online behaviour: The view of internet users with intellectual disabilities and their caregivers	safety, positive risk taking		keep safe
Chiner et al. (2021)	Exploration and comparison of the views of pre-service and in-service teachers concerning the opportunities and hazards that the internet has for students with intellectual disabilities.	education, safety		keep safe
Chinn & Homeyard (2017)	Easy-to-read and accessible information for persons with intellectual disabilities.	easy-to-read	access	
Cihak et al. (2015a)	Incorporation of functional digital literacy skills as part of the curriculum for high school students with ID.	digital skills	access, manage, integrate	
Cihak et al. (2015b)	Teaching individuals with ID to email across multiple device platforms.	digital access, communication	access	communicate
Cinquin et al. (2018)	Development of an Accessible MOOC Platform to provide ease of accessible eLearning for Accessibility/AT use, with the ability to personalize the way content for those with cognitive impairments.	digital accessibility, MOOCs, personalization	access, manage, integrate	communicate
Conley et al. (2019)	A review of literature that explores what it means to be digitally literate, the digital literacy experience for young adults with disabilities, and the implications for education and the workplace.	digital skills, education, employment	access, manage, integrate, create, evaluate	

Authors	Topic	Concepts	ETS	Verbs emerging
Cuascota et al. (2019)	Presentation of the development and evaluation of a tool for android smartphones designed to assist persons with cognitive disabilities regarding tasks for their social inclusion, with the use of Beacon technology.	social inclusion, mobile technologies	access, manage	
Daems et al. (2015)	Investigation of persons with intellectual disabilitiesD and their coaches' perceptions regarding communication with social media.	accessibility, social media	access	communicate
Delgado et al. (2019)	Testing an instructional programme aimed at increasing skills of young adults with ID to evaluate information from the internet.	instruction	evaluate	
den Brok et al. (2015)	Application of self-controlled technologies to support skill attainment in persons with autism spectrum disorder and/or ID.	emotion, cognition, daily living, VR		
Di Blasi et al. (2018)	Reading deficits in ID.	access???		
Draffan et al. (2018)	Ease of access to additional information in multiple formats when a topic is complex.	digital accessibility	access	
Easy Reading Project (2020)	A software tool that supports cognitive accessibility of web content.	digital accessibility	access, manage, integrate, evaluate,	

Authors	Topic	Concepts	ETS	Verbs emerging
			create	
Egard & Hansson (2021)	Examination of how society changes with new digital technologies, and how this can create new disabling barriers in everyday life.	digital accessibility, social inclusion	access	
Fajardo et al. (2019)	Investigation whether learning content (comprehension and monitoring of learning decisions) in the internet was enhanced or interfered by video blog (versus text blog) presentation mode for students with ID.	education	access, manage, integrate	
Fareit et al. (2018)	Insights from persons with intellectual disabilities on a transport application.	digital accessibility, transportation	access, manage	
Fernández-Batanero et al. (2022)	Current knowledge of how AR technologies are applicable, and their impact on the learning of students with educational needs, considering possibilities and challenges of these tools.	education, AR	access, manage, integrate	
Figueredo de Santana et al. (2016)	Identification of challenges and opportunities in computer-based vocational training for low-income communities of persons with intellectual disabilities.	education, vocational training	access	

Authors	Topic	Concepts	ETS	Verbs emerging
Frawley et al. (2015)	Belonging, social connections, and doing things that matter as a first-generation self-advocate.	social inclusion, self-advocacy		
FUNKA (2022)	Development and testing of five important criteria regarding cognitive accessibility (clickable objects, interactive elements, understanding of important information, indication of progress, user's location)	digital accessibility	access, manage, integrate, evaluate, create	
Ganz et al. (2015)	AAC as a means of effective communication to individuals with autism spectrum disorder	AAC, communication	access	communicate
Gibson et al. (2020)	Design of a tablet application that promotes communication between patients with mild ID and GP, along with the use of AAC technologies	communication for medical reasons	access	communicate
Guimarães & Mattos (2015)	Exploration of the use of Massive Open Online Courses for teaching students with ID and their response to the platform.	MOOCs	access	communicate
Guimarães et al. (2016)	Investigation of instructional pacing supports for teaching students with ID.	instruction	access	
Heitplatz (2020)	Exploration of how education programs should be designed to meet the needs of persons with intellectual disabilities, their formal caregivers, and social institutions.	co-design, caregivers	create	

Authors	Topic	Concepts	ETS	Verbs emerging
Hemsley et al. (2017)	Aims, scope, and methodologies of AAC social media research, with a focus on social network sites.	social media, AAC, safety, support, gatekeeping,		communicate, keep safe
Hersh (2017)	Classification framework for ICT-based learning technologies for persons with disabilities.	framework for ICT based learning technologies	access, manage, integrate, evaluate,creat e	
Hersh et al. (2015)	Recommendations for good practice regarding ICT learning technologies for persons with disability.	accessibility, training (learning)	access	
Hortizuela et al. (2022)	Presentation of an overview of the current state of web accessibility for persons with cognitive disabilities and an attempt to come up with a unified definition of web accessibility and identify its components	digital accessibility	access	
Hwang et al. (2021)	Identification of how inclusive research teams use technology during the research process that could support remote collaboration during public health emergencies like the COVID-19 pandemic.	COVID-19, co-design	create	
Iatraki et al. (2021)	Investigation of design issues regarding the development of digital learning environments that contribute to Science Education for students with ID, through	AR, co-design	create	

Authors	Topic	Concepts	ETS	Verbs emerging
	the 3D representation of invisible phenomena (molecules).			
Jenaro et al. (2017)	Internet and cell phone usage patterns among young adults with ID.	mental health	access	
Jenaro et al. (2018)	Cyberbullying among adults with intellectual disabilities.	safety, support	access	keep safe
Jiménez et al. (2015)	Video games and ID.	gaming, cognitive skills	access, manage	play
Jiménez-Lara et al. (2021)	Opportunities and challenges for inclusive education regarding students with disabilities in the digital society.	education, inclusion, digital society	access	
Johannes Kepler University & FUNKA (2022)	"Buddy" platform that assists persons with cognitive disabilities to interact with digital services by using AT.	digital services, AT	access	
Kärpänen(2021)	Cognitive accessibility in a digital environment and areas of inquiry for future qualitative research regarding cognitive accessibility.	digital accessibility	access	
Kasanen (2020)	Mapping of applications for persons with intellectual disabilitiesD.	applications		
Kaur et al. (2022)	Influence of digital media in the development of social relationships among persons with intellectual disabilities, and the role of intra-disability	digital media, social inclusion, safety	access	keep safe

Authors	Topic	Concepts	ETS	Verbs emerging
Khan et al. (2021)	Investigation of the main barriers to independent activities (e.g., travelling) for young adults with Down syndrome and the way smart devices and applications helped them perform these activities.	travelling	access	
Khanlou et al. (2021)	Examination of the barriers to access and utilization of digital technology to support the transition stage needs (in relation to education, daily living, community integration, and employment) of young adults with DD.	digital accessibility, education, daily living, social inclusion, employment	access	
Kim & Lee (2021)	Investigation regarding how adults with intellectual and developmental disabilities access the internet, and what correlates with internet usage (perspectives).	digital accessibility	access	
Kjellstrand et al. (2022)	Inclusive web-accessibility for persons with cognitive disabilities	digital accessibility	access	
Knowles et al. (2015)	Parent education for adults with ID.	carers education	access, manage, integrate, evaluate, create	
Korczak et al. (2020)	Investigation regarding whether mobile applications are used in the process of monitoring the physical activity, rehabilitation, and education of persons	physical activity, rehabilitation, education	access	

Authors	Topic	Concepts	ETS	Verbs emerging
	with intellectual and/or other disabilities.			
Koushik & Kane (2022)	Investigation regarding the way that smart devices can expand their features to support customized prompts of AR for persons with cognitive disabilities.	daily living	access, manage, integrate	
Larson et al. (2016)	Efficient vocational skills training for persons with cognitive disabilities, comparing computer-assisted instruction to one-on-one tutoring.	education, vocational training	access, manage, integrate, evaluate, create	
Lazar et al. (2018)	Co-design process of a smart phone application to help persons with Down syndrome manage their nutritional habits.	co-design, e-health	access, manage, create	
Lines et al. (2021)	Exploration of how support workers understand their role in supporting adults with intellectual disabilities to access the internet for intimate relationships.	support	access	support
Löfgren-Mårtenson (2015)	Parents and professionals' views on internet use for sexual purposes among young persons with intellectual disabilities.	safety, social inclusion, fear of loneliness	access	keep safe
Louw et al. (2020)	Enhancing social inclusion of young adults with intellectual disabilities.	social inclusion		
Lussier-Desrochers	Creation of a participatory conception model guiding the development of	co-design		

Authors	Topic	Concepts	ETS	Verbs emerging
et al. (2020)	technologies intended for the active involvement of persons with intellectual disabilities or ASD.			
Manzoor et al. (2018)	Digital technologies for social inclusion of individuals with disabilities.	social inclusion, digital accessibility	access	
Martin et al. (2021)	Investigation regarding how specific aspects of mobile devices and applications' use are associated with the social inclusion of persons with intellectual disabilities.	mobile technologies, social inclusion	access	communicate
Martins et al. (2021)	Needs of, attitudes towards, and patterns of use of digital media by persons with intellectual disabilities, and the guidelines that must be followed when developing accessible digital solutions.	digital accessibility	access	
Mateos-Sanchez et al. (2022)	The benefits of using a chatbot as educational and inclusive tool for persons with intellectual disabilities, for improving social skills and social inclusion:	social inclusion	access	communicate
McDonald et al. (2022)	Identification of strategies for facilitating inclusion of adults with ID as direct respondents in research (e.g., online).	digital accessibility	access	
Molin et al. (2015)	Parents and teachers views on internet and social media usage by students with ID.	social media, carers,		support

Authors	Topic	Concepts	ETS	Verbs emerging
Mongeau & Lussier-Desrochers (2018)	Mobile technologies used as communication support system for persons with intellectual disabilities.	mobile technologies, communication, AAC	access	communicate
Montoya-Rodríguez et al. (2022)	Analysis of the virtual reality and augmented reality programs designed to promote the development of social skills in persons with intellectual disabilities.	VR, social inclusion	access	
Morato et al. (2020)	Development of a tool for the adaptation of documents and web pages according to the easy-to-read rules.	digital accessibility	access	
Nguyen (2020)	Presentation of a conceptual framework for key dimensions of digital inclusion as well as examination of the relationship between digital technologies and social inclusion.	digital inclusion, social inclusion	access, manage, integrate, evaluate, create	
Ní Shé et al. (2021)	Identification of the psycho-social and information support needs of adolescents and young adults cancer care consumers with ID have, to generate recommendations for future research and cancer care service delivery enhancement.	digital accessibility	access	communicatio n, support
Patzer et al. (2017)	Towards an integrated system design for inclusive e-learning.	education, UDL	access	
Paulino et al. (2016)	Presentation of a music android application as a solution for music education for persons with intellectual	music education	access, create	want

Authors	Topic	Concepts	ETS	Verbs emerging
	disabilities (easy, intermediate, and advance).			
Prohn et al. (2016)	Investigation of the way that students with ID evaluate recommendations from internet forums.	internet forums	evaluate	
Raghavendra et al. (2018)	Outcomes of a home-based intervention to develop social media skills in youth with disabilities living in rural communities.	social media, digital skills, rural communities	access	
Raja et al. (2016)	Bridging the disability divide through digital technologies.	digital access, digital divide	access	
Ramsten et al. (2019)	Description of staff perceptions of the role of ICT and how it affects daily life in young adults with mild to moderate ID living in residential homes.	daily living, carer, residential homes		communicate
Rocha et al. (2015)	Interaction with digital content by persons with intellectual disabilities to perform universal tasks on the Web (searching, painting, playing games).	gaming, leisure	access	play
Rocha et al. (2016)	Performing universal tasks using a mini iPad: usability assessment per persons with intellectual disabilities.	mobile technologies	access	want
Rocha et al. (2016)	Evaluation of selection, manipulation and navigation tasks by persons with intellectual disabilities: Learning level comparison of user interaction	input access, digital skills, navigation	access, manage, integrate	

Authors	Topic	Concepts	ETS	Verbs emerging
	performance with digital content.			
Rocha et al. (2016)	Evaluating selection, manipulation, and navigation tasks by persons with intellectual disabilities.		access	
Rocha et al. (2017)	Evaluation of YouTube platform user experience by persons with intellectual disabilities.	YouTube, navigation	access	
Rocha et al. (2018)	A study regarding preferences of users with ID concerning image-type representation, with the use of eye-tracking.	digital accessibility, eye-tracking	access	
Roomkham et al. (2022)	Preliminary development of a simulated multi-modal conversational search system to understand its potentials and limitations for persons with intellectual disabilities.	communication	access	communicate
Sachdeva et al. (2015)	A framework for digital disability divide in information society.	framework, digital access, digital divide, social inclusion	access	
Salmerón et al. (2019)	Examination of the positive risk-taking and over protection notions concerning accessing the internet by persons with intellectual disabilities, by testing to what extent adults with ID select relevant and trustworthy pages during internet	searching accessibility, safety	evaluate	keep safe

Authors	Topic	Concepts	ETS	Verbs emerging
	searching.			
Salvador-Ullauri et al. (2020)	Web-accessibility for serious games regarding persons with cognitive, motor, and sensory disabilities.	digital accessibility, gaming	access	play
Schlomann et al. (2021)	Analysis of learning strategies, preferences, and learning settings of older adults with and without ID, regarding learning ICT, with emphasis on self-regulation.	education, life-long learning		
Senaratne et al. (2022)	Design, development, and evaluation of a curated set of accessible electronic modules.	co-design	access	create
Seok et al. (2017)	Digital literacy of youth and young adults with ID and prediction by support needs and social maturity.	digital skills, support		support
Sheehan et al. (2017)	Exploration of digital mental health for persons with intellectual disabilities.	digital access, safety	access	keep safe
Sitbon et al. (2018)	An exploration of how persons with intellectual disabilities engage with online information retrieval.	digital skills, searching accessibility	access	
Sitbon et al. (2020)	Engagement of adults with ID with videos on the YouTube platform and development of a framework for the evaluation of large video repositories, with focus on search (browsing) accessibility	Searching accessibility, YouTube	access, manage	

Authors	Topic	Concepts	ETS	Verbs emerging
Sitbon et al. (2020)	Examination of an ability-based and participatory design, in order to increase the involvement and engagement of persons with intellectual disabilities in interactive information retrieval research. Development of a tool that works as a search application for videos, to assist persons with intellectual disabilities to learn (in an online module) life skills that they considered important.	searching accessibility, online learning, life skills	access	
Song & Deng (2020)	Analysis whether technology could effectively promote the impact scaling of NGOs providing services for adolescents with ID.	online services	access	
Spencer González et al. (2020)	Presentation of a series of methods and adaptations carried out in the context of inclusive research, for the participation of persons with intellectual disabilities in participatory design processes.	co-design	create	
Spriggs et al. (2015)	Embedding video models into visual activity schedules to increase independence for students with ASD.	digital accessibility	access	
Stephenson et al. (2015)	Use of touch-screen mobile devices by persons with developmental disabilities.	touch devices, digital skills training		
Sutherland et al. (2016)	The evidence for easy-to-read for persons with intellectual disabilities.	easy-to-read		

Authors	Topic	Concepts	ETS	Verbs emerging
Terras et al. (2018)	The opportunities and challenges of serious games for persons with an ID.	gaming	access, manage	
Torrado et al. (2020)	Investigation of the development of an e-health software (Android exergame) that can motivate persons with intellectual disabilities to do physical activity outdoors, by enhancing the physical activity of walking with a gamified experience through the story and reward system:	e-health, gaming	access	navigate, communicate
Vasquez III (2015)	Virtual learning environments for students with disabilities.	VR, social inclusion, personalization	access	
Venkatasubramanian et al. (2021)	The development of a mobile computing-based reporting tool for empowering individuals with I/DD to self-report abuse	other		
von Barnekow et al. (2017)	3D gamified simulations as valid vocational training tools for persons with intellectual disabilities.	3D gaming, engagement, vocational training		play, want
Waight et al. (2016)	Search for websites that were offering accessible information for adults with ID.	health, social care, advocacy, leisure, transition to adulthood	access, manage	

Authors	Topic	Concepts	ETS	Verbs emerging
White & Forrester-Jones (2020)	Adaptation of the Social Network Guide (system for measuring the structural, interactional, and supportive aspects of individual's networks) according to the needs of adolescents with and without ID.	social inclusion		
Whiteley et al. (2015)	Perspectives of older persons with intellectual disabilities on understanding and experiencing ageing.	aging		
Williams et al. (2022)	Investigation of web usability with persons with intellectual disabilities.	digital accessibility	access	
Wilson et al. (2016)	Development of a mobile application to enable young adults with ID to produce an image of themselves and achieve a certain goal.	communication	access, create	communicate
Wilson et al. (2017)	Supporting the interest-based learning of words through a personal visual dictionary.		access	share vs communicate
Wu et al. (2020)	Application of the "Virtual Reality Vocational Skills Training System" to vocational high school students with ID, simplifying the operation of the original system and developing an easy-to-use version to meet the learning needs of students with ID.	education, VR, easy-to-read	access	
Wyeth et al. (2015)	Observations of persons with intellectual disabilities interacting with a floor-based system that allows users to interact with	TUI	access	

Authors	Topic	Concepts	ETS	Verbs emerging
	digital environments by triggering pressure sensors embedded within a 2×3-meter floor mat.			
Zhang et al. (2016)	Enhancement of Web Accessibility for persons with disability.	digital accessibility, 3D printing, NFC	access	