Electronics and Employability Advancement for Adults with Down Syndrome

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WP3.1 NATIONAL DESK RESEARCH

This report lays the foundation for developing the training format and digital tools through conducting national-level research with 1) Key information about the educational needs of adults with Down Syndrome in technology-related learning; and 2) Best practice examples of existing methodologies, tools or materials already used to educate adults with intellectual disabilities (especially in electronics, coding, tinkering or general digital training).

Country: ITALY

Co-funded by the European Union

Introduction

This national research was carried out by Quality Culture in the framework of WP3.1 of the FEAT-DS project. Its main objective is to explore the educational needs of adults with Down syndrome in Italy, especially in relation to digital and technical learning. The findings will help shape the content, methods and tools that will be developed later in the project, with a specific focus on electronics, coding and accessible design. This research is not academic in purpose. Its goal is practical: iIt will directly inform the co-design process of the training format and digital tools foreseen in WP3.

Italy has a long history of working on inclusive education, but when it comes to digital skills and access to technology, significant gaps still remain, particularly for adults with intellectual disabilities. Despite some successful local initiatives and tools already in use, the national picture is fragmented, and few resources are fully adapted for people with Down syndrome. This is where our work in FEAT-DS becomes especially relevant.

By collecting both the barriers and the best practices, this report aims to offer concrete recommendations for the development of learning materials and inclusive tools that can be used across Europe. In this context, we also tried to reflect the voices of learners and educators, whenever possible, to make sure our proposals stay grounded in real-life experiences. We looked at several existing practices in Italy, such as the use of block-based programming (Scratch), creative electronic kits (Makey Makey), and symbol-supported writing software (SymWriter). These are not perfect solutions, but they offer promising directions.

The FEAT-DS project has the opportunity to build on these experiences and go further by blending tinkering, coding and accessible design in a training format specifically tailored for adult learners with Down syndrome. This report is our first step in that journey.

Educational Needs Overview

Adults with Down syndrome often face significant obstacles on their path to independence: one of the most common issues is delayed language development (it's important to clarify that this condition does not definitively preclude the development of communication skills). With the right tools (such as visual aids, accessible technologies and specially designed educational environments), many people with Down syndrome are able to achieve good levels of expression.

Other frequently encountered cognitive difficulties include reduced short-term verbal memory, which can make it difficult to remember instructions that have been heard, and weakness in so-called executive functions: planning, maintaining attention, managing sequential tasks and problem solving. In some cases, there are traits associated with attention disorders or hyperactivity which can make it more difficult to participate in structured programmes.

Although visual processing is one of the strengths of many individuals with Down syndrome, it can also have limitations, especially when it comes to understanding overly complex images or visual sequences. This makes the use of non-inclusive digital interfaces an additional factor of exclusion. These cognitive challenges are compounded by those related to the social sphere: the development of interpersonal skills often takes longer, with a direct impact on participation in group dynamics, which are very common in educational contexts.In order to respond effectively to this variety of obstacles, educational intervention for people with Down syndrome must be based on an integrated and flexible approach: it is not a single technique that makes the difference, but the construction of an environment that brings together visual stimuli, practical experiences, simplified language and functional repetition. Many people with Down syndrome learn better through visual channels: diagrams, photographs, videos, symbols and graphic materials facilitate access to content by lightening the cognitive load associated with linguistic comprehension. This is where Augmentative and Alternative Communication (AAC) comes in, which includes the use of tools such as tables, software, symbols and mobile devices. Another support tool is bimodal communication, which combines spoken words with gestures borrowed from or inspired by sign language.

Learning through direct action (the "Hands-On" approach) is another key element: practical contact with objects and activities facilitates the transition from theory to practice. The language used in educational activities should be direct, unambiguous and not overloaded with information. When accompanied by targeted repetition and the presentation of content in different forms (visual, practical, auditory), this approach increases the effectiveness of the memorisation process. In the Italian context, there are several significant experiences in the field of accessible technology. Projects such as "App and Out" by the AIPD in Bergamo allow for independent management of free time thanks to simple and visual interfaces. The use of voice assistants such as Alexa, in initiatives such as "Ragazzi in Gamba", facilitates interaction with technology through voice, offering an alternative to reading or typing. Organisations such as the ASPHI Onlus Foundation, the Lega del Filo d'Oro and numerous social cooperatives also promote accessible digital tools and computer literacy courses for people with intellectual disabilities.

Despite these positive examples, structural problems remain in Italy: digital barriers remain widespread, despite legislative progress such as the Stanca Law (No. 4/2004) and the European Accessibility Directive (2019/882). Many digital services are still not accessible. To ensure equal opportunities in the digital sphere, constant political commitment, greater consistency in policy implementation and the introduction of monitoring mechanisms to assess the effectiveness of the practices adopted are essential. Only through integrated and systemic action will it be possible to promote the real participation of people with Down syndrome in the digital society, recognising their rights, potential and dignity as full citizens.

Best Practice Examples

Scratch – Block-Based Programming Platform

Target Audience: Students (from primary school upwards) with various disability profiles, particularly motor disabilities, learning disorders, and autism spectrum disorders. The goal is to teach computational thinking, programming logic, and foster creativity.

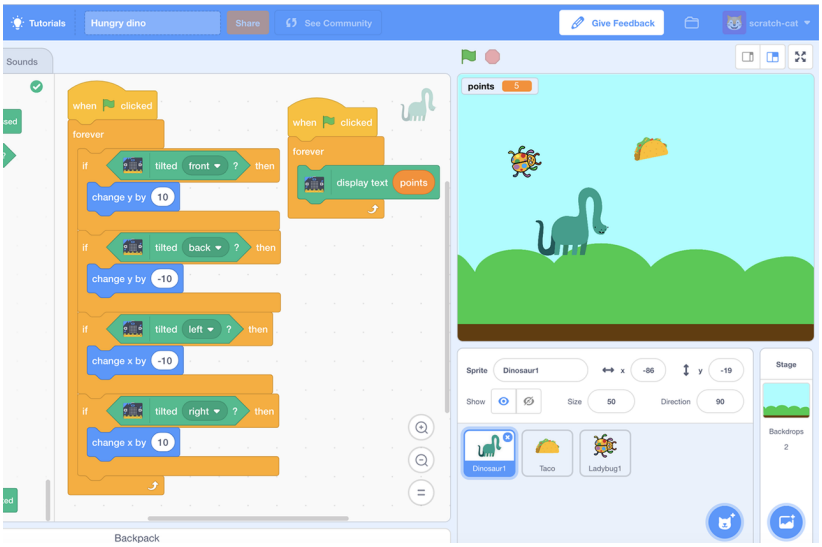
What it does: It is a visual programming environment that allows users to create interactive stories, games, and animations. It uses interlocking code blocks (similar to building bricks), eliminating the need for writing textual code and making programming more intuitive.

Inclusive/Effective Design:

- Drag-and-Drop Interface: The block-based drag-and-drop interface is accessible to those who struggle with writing or the complex syntax of traditional programming languages.
- Highly Visual Nature: The strong visual impact and the ability to achieve immediate visual results are highly engaging and motivating for students with learning or behavioral disorders.
- Keyboard Accessibility: Based on Google's Blockly, it supports full keyboard navigation, which is essential for users with motor disabilities who cannot use a mouse.
- Screen Reader Support: Ongoing developments aim to improve screen reader support, making the platform increasingly usable by individuals with visual impairments.

Why it is pertinent to FEAT-DS:
It is highly relevant because it exemplifies a successful model for teaching programming to individuals with intellectual disabilities. Scratch's approach, abstracting syntax complexity in favor of visual logic, is directly applicable to adult learners with Down syndrome.

Link:https://www.agendadigitale.eu/scuola-digitale/coding-a-scuola-quanto-e-diffuso-in-italia-e-le-nuove-frontiere-di-applicazione/



Block-based interface based on the Scratch programme.

Makey Makey - Invention Kit

Target Audience: Universal audience (children, educators, makers). Particularly effective for people with disabilities (motor, cognitive) in educational, rehabilitative, and creative settings to encourage exploration and interaction.
What it does: Makey Makey is an electronic board that turns any slightly conductive object (fruit, playdough, graphite, water, the human body) into a computer key. By connecting objects to the board using alligator clips, users can control programs, video games (such as those created with Scratch), or digital musical instruments in physical and unconventional ways.
Inclusive/Effective Design:

- Plug-and-Play: No driver installation or programming skills are needed for basic use—it is recognized by the computer as a simple external keyboard. Using alligator clips is intuitive and requires no soldering.
- Alternative and Adaptive Input: It provides an immediate alternative to the mouse and keyboard, crucial for users with motor impairments. It allows the creation of customized controllers tailored to the user's physical abilities (e.g., large buttons made of cardboard and aluminum).
- Cause-and-Effect Learning: It makes the connection between a physical action (touching a banana) and a digital reaction (a sound or animation on the screen) immediately tangible, reinforcing the understanding of cause-effect relationships.
- High Sensory Engagement: Physical interaction with everyday objects makes learning a fun, creative, and multisensory activity.

Why it is pertinent to FEAT-DS:
Makey Makey embodies accessible electronic tinkering and pairs perfectly with block-based programming. For adult learners with Down syndrome, it serves as an ideal bridge between the

physical and digital worlds. The key insight to be leveraged in WP3 is that linking a personalized physical input (the "touch") to a digital output (programmed with a block-based tool like Scratch) makes the concepts of "input/output" and "control" extremely concrete and motivating. This playful approach lowers performance anxiety and transforms electronics and coding education into a creative exploration.

Impact:

Children and young people with cognitive and motor disabilities often cannot use traditional keyboards or mice, but they are eager to experiment and carve out their own spaces of autonomy.

Link:

https://lacasadisabbia.org/scratch/

Makey Makey device connected to colored clay

SymWriter 2 – symbolic writing software

Target Audience: Children and young people with intellectual disabilities, reading difficulties, and/or users of augmentative and alternative communication (AAC) systems. Usable both individually and in small group settings. The goal is to support the development of reading, writing, and communication skills.

What it does: SymWriter is a program that allows users to write texts that are automatically accompanied by symbols, making written language easier to understand. Its advanced linguistic features support grammatical and semantic analysis during the writing process.

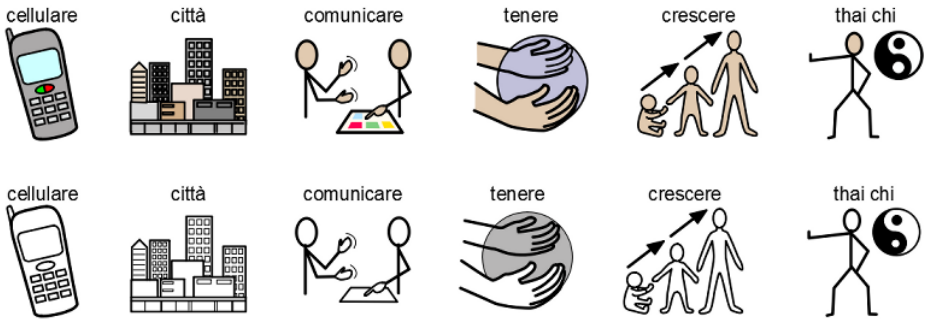
Inclusive/Effective Design:

- Automatic association of symbols with written text
- Simplified, visual language
- Customizable interactive grids for educational activities
- Auditory feedback (letters, words, sentences)

- Symbol visualization and selection to reinforce language discrimination
  Simple interface suited to users with complex communication needs

Why it is pertinent to FEAT-DS: SymWriter is highly relevant to FEAT-DS because it promotes access to reading and writing through visual and multisensory strategies, which are especially beneficial for adult learners with Down syndrome. The use of symbols to support language comprehension can be integrated into tinkering, coding, or guided design activities, providing an accessible communication model. The interactive grids offer a valuable approach for WP3, where the development of digital tools tailored to the cognitive and communication needs of users with Down syndrome is foreseen.

Link:
https://sd2.itd.cnr.it/index.php?r=site/scheda&id=5751



Augmentative and alternative communication used in software SymWriter

Insight for WP3 Co-Design

The desk research revealed several key ideas that should directly influence how we co-design the training materials and platform for FEAT-DS. These insights come from both the analysis of learner needs and the features found in good practices already in use in Italy.

1. Training should be hands-on and playful.
Learning by doing works very well for people with Down syndrome. It helps connect abstract ideas to something concrete. Tools like **Makey Makey** and **Scratch** are not only educational, but also fun. They allow learners to experiment without fear of making mistakes. In our training format, we should give learners chances to "play to learn", by trying out circuits, programming simple commands, or building something real and visual.

2. Visual support is essential.
Visual aids are necessary. Diagrams, pictograms, large buttons, and colour-coded categories make it easier to follow steps, remember tasks, and feel oriented. Platforms like **SymWriter** show how symbols and icons can guide learners and lower the pressure from reading or writing full text. Our training materials should use consistent visual language, repeated throughout all modules. Also, we should consider adding optional audio instructions and "read aloud" functions.

3. Keep language simple, short and positive.
Many adult learners with Down syndrome struggle with complex sentences or instructions. Long paragraphs or academic words should be avoided. Instead, we suggest using short, active sentences. For example, instead of “Identify the connection between the inputs and outputs of the electronic board,” just write “What happens when you touch the banana?”. Also, instructions should always be positive and encouraging. Mistakes should be treated as normal or even part of the learning process.

4. Let them personalize the experience.
Whenever possible, the learner should have the chance to choose colours, objects, sounds or icons they prefer. This helps with engagement and gives a sense of control. For example, in Makey Makey, users can decide to use apples or metal spoons as input tools. That kind of freedom should be included in our training, too (not only for fun, but because it respects personal preferences and supports self-determination).

5. Avoid clutter, reduce steps.
Digital interfaces with too many elements, or training activities with too many steps, can create confusion and frustration. Every screen or task should have one clear goal. Avoid multiple scrolls, pop-ups, or too many navigation buttons. Testing with the target group will help find the right balance between richness and clarity.

6. Build small goals and visible results.
Learners feel more motivated when they can see that they’re making progress. Our training should be divided into clear levels, with short tasks that give feedback. A sound, a star, a message like “Well

done!” can make a big difference. This kind of structure reduces anxiety and supports memory. Even better if progress can be saved or shared with a caregiver or educator.

7. Support the educators, too.
Many adult educators are not tech experts. They need clear instructions, background guides, and simple ways to adapt the material. Our training kit should include printable guides, video tutorials, and tips for working with different profiles of learners with Down syndrome. Co-creation with educators during WP3.2 will help ensure this.

8. Make accessibility a priority, not an afterthought.
Accessibility should not be “added on” at the end. It should guide all choices, from font size to screen-reader compatibility. Even more, we should test our tools with real users before finalising. People with Down syndrome (and their educators) must be involved not only in using the platform, but in shaping it.

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