

WEARABLE-ASSISTED TASK SUPPORT FOR CHILDREN WITH AUTISM SPECTRUM DISORDER IN EDUCATIONAL CONTEXTS

Noé Vila¹, Paula M. Castro², & Adriana Dapena²

¹*Department of Computer Engineering, University of A Coruña (Spain)*

²*Department of Computer Engineering, University of A Coruña & CITIC (Spain)*

Abstract

Children diagnosed with Autism Spectrum Disorder (ASD) often experience difficulties maintaining attention and completing daily routines independently. This paper presents a wearable-based support system aimed at enhancing autonomy and task-sequencing skills through two synchronized applications for Apple Watch and iPhone. Developed with Apple native tools, the system features interfaces and pictographic elements. Generative artificial intelligence (AI) assists caregivers and educators in automatically decomposing tasks into personalized, step-by-step routines displayed on the smartwatch. The system was validated through a mixed-method study involving educators and families from local ASD support associations. Evaluation included functional and usability testing across multiple devices, as well as a Likert-based satisfaction survey. Results indicate that wearable visual cues positively influenced children's engagement with everyday tasks, increasing predictability and reducing stress. These findings highlight the potential of accessible wearable technologies to support autonomy and participation in inclusive education, with ongoing work focused on adaptive feedback, customizable visuals, and classroom-oriented analytics.

Keywords: *Inclusive education, wearable technology, task management, assistive applications, ASD.*

1. Introduction

In inclusive education, supporting autonomy in daily routines is a practical and pedagogical priority for many children with ASD, especially when sustained attention, planning, and transitions affect participation (American Psychiatric Association, 2013). Educational practice frequently relies on structured prompts, visual supports, and stepwise task guidance to reduce uncertainty and support engagement across classroom and home contexts. However, these supports are not always available at the point of need, can depend on adult mediation, and may be difficult to generalize across settings.

Wearable devices provide an opportunity to deliver discreet, always-available prompts that travel with the learner, potentially strengthening continuity between school and family routines. To operationalize this potential, this paper presents an education-oriented intervention: a synchronized Apple Watch–iPhone system that externalizes routines into short, pictographic prompts and logs outcomes for reflective follow-up (Cooper et al., 2020).

This paper is organized as follows. Section 2 shows the educational objectives of this proposal. The intervention design is explained in Section 3, and Section 4 is devoted to methods for this work. Finally, Section 5 gives some results and a brief discussion about them, while the main conclusions are presented in Section 6.

2. Educational objectives

The intervention is designed to support competencies commonly addressed in individualized and inclusive education programs:

- i. Autonomy and task completion, by reducing reliance on adult prompting.
- ii. Task-sequencing and executive functioning, by presenting routines as small, manageable steps.
- iii. Predictability and emotional regulation, by clarifying what is happening now and what comes next.
- iv. School and family coordination, by enabling shared routine definitions and consistent supports across contexts.
- v. Data-informed adjustment, through simple indicators (completion, help requests, time usage) that guide educators' and families' reflective practice without shifting the focus to surveillance.

3. Intervention design

The system consists of two synchronized applications. The Apple Watch app is learner-facing: it provides routine prompts and step-by-step guidance using pictographic supports. The iPhone app is adult-facing: it enables educators and caregivers to define routines, select pictograms, and review basic interaction outcomes.

3.1. Learner-facing interaction on Apple Watch

The Apple Watch interface is designed to minimize cognitive load: it prioritizes large pictographic cues (ARASAAC, 2026) and short, consistent interaction patterns. Each routine is presented as a sequence of steps, with a strong emphasis on immediate clarity (“what to do now”). The smartwatch delivers cues discreetly, supporting participation without drawing unnecessary attention. A central design decision is the use of short visual prompts to improve predictability. Predictability is treated as an instructional scaffold: when routines are clear and consistent, children may experience greater control during transitions, which can improve cooperation and reduce stressors associated with ambiguous instructions.

A playful “coin” micro-interaction was added to increase engagement without adding navigational complexity: a short tap on the circular progress element triggers a 3D rotation animation. On the reverse side, the interface displays concise task metadata (task name in uppercase and start/end times using symbols and numbers), providing additional information while preserving low-text interaction (see Figure 1).

Figure 1. Coin-like flip interaction used to reveal task metadata on Apple Watch.



3.2. Adult-facing authoring and follow-up on iPhone

The iPhone app supports routine authoring by educators and families, allowing them to create personalized, step-by-step sequences and associate each step with pictographic elements. It also provides a lightweight review of outcomes based on watch interactions (e.g., completion results and help requests), enabling adults to adjust routines pragmatically (step granularity, time allocation, or reinforcement strategies).

4. Methods

The following subsections describe the development approach and mixed-methods validation.

4.1. Development approach and accessibility principles

The intervention was developed in collaboration with a local association supporting children with ASD in A Coruña, Spain. Guided by Universal Design for Learning principles, which emphasize reducing access barriers and providing multiple means of representation (CAST, 2018), interface decisions prioritized pictographic supports, reduced text dependence, and stable interaction patterns.

4.2. Generative AI for task decomposition

To support educators and caregivers in creating effective stepwise routines, tasks were automatically decomposed with the assistance of generative AI. The educational intent of this component is practical: it helps adults convert broad activities into developmentally appropriate steps that can be reviewed and refined by the educator/caregiver, improving feasibility and consistency of routine authoring. This approach also promotes autonomy for the smartwatch user by enabling an automated help mode based on pictographic prompts, allowing the child to access step-by-step support discreetly and with reduced reliance on adult intervention.

4.3. Mixed method validation

A mixed-method validation was conducted with educators and families through collaborating associations. The evaluation combined:

- i. Functional and usability testing across multiple iPhone and Apple Watch models to confirm operational robustness and consistent interaction.

- ii. A Likert based satisfaction survey to capture perceived usability and educational value. Qualitative feedback was additionally collected to identify improvements relevant to diverse learner profiles and authentic classroom/home constraints.

5. Results and discussion

Findings indicate that wearable cues positively influenced how children approached everyday tasks, as reported by educators and families. By externalizing routines into short, visual prompts, the system increased predictability and control, which was associated with reduced stress and improved cooperation in learning and domestic activities.

From an educational perspective, this suggests that the intervention's value is not solely in reminding, but in providing an accessible "external executive scaffold" that supports task initiation and step transitions. The wearable format also supports continuity across contexts: routines follow the learner rather than being tied to a pictogram-based wall schedule or an adult's phone.

The ASD local association feedback emphasized the importance of personalization. Because ASD profiles are heterogeneous, the visual vocabulary and step granularity vary by age, preferences, and sensory or cognitive needs. The system's reliance on pictograms is beneficial for many learners, but adults requested flexibility to adapt visual sets and levels of detail.

6. Conclusions and educational implications

This study presented an education-focused, wearable-based routine support system integrating synchronized Apple Watch and iPhone applications to enhance autonomy and task sequencing for children with ASD. The pilot validation with educators and families supports the pedagogical relevance of visual wearable prompts as mediators of predictability, participation, and reduced routine related stress.

For inclusive education practice, the work suggests three practical implications: (i) wearable prompts can reduce dependence on adult mediation at the point of need, (ii) stepwise routines can function as a scalable instructional scaffold across settings, and (iii) lightweight outcomes enable reflective routine tuning without imposing high documentation burden.

Acknowledgments

The authors thank the participating local associations, educators, and families for their collaboration, feedback, and involvement in the validation activities.

This work has been partially funded by ED431C 2024/18 of the Xunta de Galicia.

References

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Arlington, VA: American Psychiatric Association.
- CAST. (2018). *Universal Design for Learning Guidelines* version 2.2. Wakefield, MA: Author.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied Behavior Analysis* (3rd ed.). Boston, MA: Pearson.
- Portal Aragonés de la Comunicación Aumentativa y Alternativa (ARASAAC). (n.d.). ARASAAC pictograms. Retrieved January 5, 2026, from: <https://arasaac.org/>