

AAC Beyond the Tool: Building the Extended Mind in Inclusive Learning Ecosystems

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Abstract: This paper looks at Augmentative and Alternative Communication (AAC) not just as a compensatory tool, but as a core part of the “extended mind” within educational ecosystems. Moving beyond a narrow, individual-focused view of disability, AAC is seen through a Batesonian lens as a network of signs and technologies that creates feedback loops between people, their environment, and culture. In this perspective, cognition is not confined to the individual—it emerges from the ongoing interaction between the user and their communicative tools, making learning an ecological, shared, and dynamic process. The article also explores how schools, understood as learning communities, can evolve toward more collaborative forms of governance, where communication is a shared responsibility grounded in context. It considers the growing role of agentic Artificial Intelligence, which can reshape how decisions are made and communication unfolds, raising new ethical questions about who “owns” thought in hybrid human–AI systems. The paper argues that AAC embodies the vision of the post-digital school: an environment where inclusion is not an afterthought, but the natural starting point for a system that learns, adapts, and grows through its own artifacts.

Keywords: Augmentative and Alternative Communication; Educational ecosystems; Distributed Cognition; Extended Mind; Post-digital Inclusion.



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1. Introduction

When we think about Augmentative and Alternative Communication (AAC), we often imagine a set of tools designed to fill an individual gap. In this traditional view, a symbol book or a speech-generating device is an extension that stops where the user’s body begins (Biggs, & Hacker, 2021). Yet, if we analyze closely the realities of our educational ecosystems, this perspective feels far too narrow. The limitations of an atomistic view of the mind are now undeniable, pushing us to look elsewhere: not inside the individual, but in the spaces between people, objects, and the environments they live in.

In this framework, learning is not a solitary accumulation of information; it is a distributed and embodied process. When a student uses AAC to interact with peers or to interpret a lesson, they are not simply using a “tool”; they are activating a cognitive

circuit that engages the teacher, the device, the class, and the physical environment. As Clark and Chalmers (1998) suggest, the mind “extends” beyond biological boundaries to inhabit the cultural and technological artifacts that become integral to our thinking (Clark, 2008).

This article explores AAC as the most tangible expression of this “extended mind.” Drawing on the work of Gregory Bateson (1972), we show how a system of symbols is not merely a support, but a “difference that makes a difference” within a complex relational ecology. In an increasingly interconnected, post-digital world (Rivoltella, 2020), AAC is no longer a crutch for a few; it is a systemic pedagogical device. The goal is to redefine AAC as a resource that transforms schools into learning communities, where communication is not an act of the individual, but an emergent property of the entire cognitive ecosystem.

2. The Extended Mind and the “Difference Circuit”

In the introduction to this contribution we have mentioned the term Augmentative and alternative Communication and, before moving on, it needs to understand precisely what it is and how it works. As the term implies, AAC can be understood as a shared communication system that enables meaningful interaction through alternative channels. According to Yoder and Kraat (1983), individuals who use AAC are those who “cannot express what they want, when they want, and how they want.” AAC can be broadly divided into two categories: unaided and aided methods.

Unaided AAC relies entirely on the body and includes facial expressions, gestures, body movements, and signs. Many unaided methods, such as eye gaze or simple gestures, are widely understood and used in everyday communication. Sign language also falls under unaided AAC. For individuals with limited speech or motor abilities, modified or individualized signs from a sign language can be employed to express needs and intentions (Saini, & Kumar, 2026).

Aided AAC, on the other hand, involves the use of external tools and devices, which can be further divided into “no/low-tech” and “high-tech” options. No- or low-tech aids are non-electronic and require no batteries; examples include objects, pictures, written symbols, communication boards, and books such as PECS. Using images for communication, for instance, is considered “alternative” because it provides a non-verbal channel, while also being “augmentative” because it supports and enhances interpersonal interaction through a visual code. In essence, AAC allows information to be exchanged through a variety of means, aiming to enhance the quality and effectiveness of existing communication skills without entirely replacing the user’s natural language.

If we follow Bateson’s (1972) invitation to stop looking for the mind under the skull and instead examine interaction circuits, AAC ceases to be a “special language” and becomes the very architecture of collective thought. In a classroom where augmentative communication is practiced, the “difference that makes a difference” is not stored in the tablet or symbol book, but in the way those artifacts reorganize relationships.

Imagine a familiar moment: a student selects a concept using an eye-tracker or a paper-based communication board. At that precise instant, the boundary between their communicative intent and the tool begins to blur. As the extended mind theory suggests (Clark & Chalmers, 1998), the artifact is not merely an external “channel” but

a constitutive part of the cognitive process. Without that support, the specific thought could not emerge in the same way; with it, the student's mind extends into the environment, anchoring itself to symbols and technologies that enhance their agency.

This learning ecology, however, does not concern only the student with complex communication needs—it involves the entire “classroom system.” When a peer or teacher responds to that symbol, they enter a cybernetic feedback loop (Bateson, 1979) where information circulates and transforms. AAC thus becomes a mediator that allows the mind to be “distributed”: knowledge is no longer a private possession of the individual, but the outcome of a dance among bodies, visual codes, and environmental responses.

From this perspective, extended learning within educational ecosystems appears as a process of co-evolution. The student does not need to “adapt” to the tool, nor does the tool simply “serve” the user. Instead, the entire system learns to operate according to a new grammar, where the fragility of one becomes an opportunity for cognitive restructuring for all. The mind, then, “resides” in the process that connects the child to their symbol and the symbol to the world's response.

3. Educational Ecosystems and the Governance of Collective Mind

If the mind resides in relational circuits, then the school itself must be reimagined as a single learning organism. Within this framework, AAC stops being a “special” technical intervention and becomes a strategy for governing learning. It is no longer enough for a student to have their own tool; the entire school ecosystem—leaders, teachers, staff, and families—must recognize itself as part of a collective mind (Ianes & Cramerotti, 2020).

From an ecological perspective, the governance of inclusion cannot be imposed from above; it must emerge from distributed leadership. This means that responsibility for communication is not delegated to the expert on duty, but becomes a shared commitment. When a school chooses to adopt AAC as a common language—by symbolizing spaces or training all staff on it—it is effectively managing the complexity of the system through professional cooperation.

Agency, the capacity to act and influence reality, no longer belongs just to the individual. As systemic perspectives emphasize, it is distributed: it emerges from territorial alliances and inter-institutional networks that support the student's journey. A school that “learns as a system” is one that knows how to weave these networks, turning every communicative barrier into an opportunity for shared reflection (Robinson, & Soto, 2021).

The crucial shift is therefore from a “walled school” to an extended educational community. In this ecosystem, educational design is not a solitary bureaucratic act but a dynamic co-creation. AAC becomes the thread that connects the various nodes of the network, making visible that institutional intelligence does not reside in circulars or directives, but in the system's ability to keep feedback circuits open among all participants.

4. Extended Environments: When Space Learns and Communicates

From the perspective of extended learning, classrooms and school spaces can no longer be seen as neutral containers or inert backdrops. On the contrary, they act as genuine “cognitive agents” that actively participate in the construction of meaning. When AAC moves from the student’s notebook to doors, play corners, labs, or gardens through environmental symbolization, the physical space begins to “speak,” guiding the practices and relationships of everyone within it.

This transformation makes the space hybrid and post-digital (Rivoltella, 2020): an environment where the boundary between analog (printed symbols) and digital (communication software or QR codes linking to audio content) fades into a unified learning ecology. In this context, the environment does not merely host the student; it supports them, continuously providing visual cues that extend their capacity for orientation and decision-making. This is what we might call a “networked school,” where every corner is designed to reduce cognitive load and enhance autonomy.

A central role in this ecology is played by modeling—the use of AAC by adults and peers. It is no longer only the student “with special needs” who must use the symbols; the entire human environment speaks that language. This transforms the relational climate: communication becomes an immersive experience, similar to learning a foreign language in a country where it is spoken everywhere (Pagliara et al., 2025).

Extended space, then, does not end at the school walls. It reaches into family and community ecologies, creating a continuity of meaning between school, home, and the wider territory. A space configured in this way is not merely inclusive; it is an environment that “thinks together” with its inhabitants, where cultural artifacts and signs form the fabric upon which real participation is woven—making visible that the mind does not reside in the individual alone, but in the distributed process connecting them to the surrounding world.

5. Artificial Intelligence and Cognitive Agency: New Horizons for Voice

The emergence of Artificial Intelligence in educational ecosystems should not be seen as the arrival of an outsider, but as the natural evolution of the extended mind we have described so far. If AAC has always served as a bridge between thought and the world, agentic AI transforms that bridge into a living pathway, capable of learning and adapting to the steps of those who traverse it. From this perspective, AI is not merely a “data processor,” but a cognitive agent actively participating in the dance of communication.

Consider the new frontiers of predictive AAC: systems that, learning from interaction patterns, suggest vocabulary or construct phrases from a single glance. Here, reasoning is no longer purely human or purely artificial; it becomes a hybrid process. This “augmented mind” allows the student to reduce the effort of translating thought into symbol, freeing energy for relationship and learning. Yet this new form of agency raises profound pedagogical and ethical questions: in a system where the machine “anticipates” communicative intent, who is truly speaking?

The answer lies in the educational governance of AI. We cannot leave it to the algorithm to define the boundaries of the cognitive system. It is the role of the learning community to guide these technologies so that they remain tools of em-

powerment rather than replacement. AI must be designed as a component of a Batesonian cybernetic system, capable of providing meaningful feedback that helps the student recognize themselves as the author of their own message (Williams, & Holyfield, 2025).

In this scenario, the responsibility of teachers and designers shifts to the quality of the human-machine relationship. The goal is not to create perfect, error-free communication, but authentic communication, where Artificial Intelligence acts as a catalyst of possibilities. Only in this way can the extension of the mind through AI be genuinely human, keeping the person—and their irreducible uniqueness—at the center of the vast ecosystem of the network.

6. Conclusions

Viewing Augmentative and Alternative Communication through the lens of the extended mind allows us to make a shift in perspective that is, above all, an act of openness and welcome. The deepest lesson AAC offers to today's schools is a truth both simple and radical: no thought arises in a vacuum; every idea, every word, needs the support of the world and of others to come to life.

In this ecology of possibility, inclusion is no longer measured by the number of support hours or by simply providing a tablet, but by the care we take in keeping communication channels open. If we accept that the mind is a process extending beyond our skin, then the school itself must “become a mind,” transforming the fragility of the individual into a responsibility shared by all. The horizon opened by Artificial Intelligence and post-digital environments should not frighten us, but call us to a renewed presence. Governing extended learning means safeguarding the boundaries of the human, ensuring that technology remains an extension of voice rather than a cold replacement. The challenge for future research will be precisely this: designing educational ecosystems where every artifact—from the simplest card to the most sophisticated algorithm—serves authentic participation.

References

- Bateson, G. (1972). *Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology*. Chandler Publishing Co.
- Bateson, G. (1979). *Mind and nature: A necessary unity*. Dutton.
- Biggs, E. E., & Hacker, R. E. (2021). Ecological systems for students who use AAC: Stakeholders' views on factors impacting intervention and outcomes. *Research and Practice for Persons with Severe Disabilities*, 46(4), 259-277.
- Clark, A. (2008). *Supersizing the mind: Embodiment, action, and cognitive extension*. Oxford University Press.
<https://doi.org/10.1093/acprof:oso/9780195333213.001.0001>
- Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, 58(1), 7–19.
<https://doi.org/10.1093/analys/58.1.7>

- Costantino, M. A. (2011). *Costruire libri e storie con la CAA. Gli IN-book per l'intervento precoce e l'inclusione*. Erickson.
- Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality*. Oxford University Press.
- Heersmink R. (2020). Varieties of the extended self. *Consciousness and cognition*, 85, 103001.
<https://doi.org/10.1016/j.concog.2020.103001>
- Hutchins, E. (1995). *Cognition in the wild*. MIT Press.
- Ianes, D. (2014). *L'evoluzione dell'insegnante di sostegno. Verso una didattica inclusiva e una governance dell'apprendimento*. Erickson.
- Luckin, R. (2018). *Machine learning and human intelligence: The future of education in the 21st century*. UCL IOE Press.
- Pagliara, S. M., Pia, M., Bonavolonta', G., Lazareva, V., Dimitrovska, M. M., Mavrou, K., ... & Mura, A. (2025, September). The VoiceKids Knowledge Hub: An Innovative Open Educational Resource Integrating Instructional Design, Assistive Technology, and AAC for Inclusive Teacher Training. In *International Conference of the Association for the Advancement of Assistive Technology in Europe* (pp. 62-68). Cham: Springer Nature Switzerland.
- Rivoltella, P. C. (2020). *Nuovi alfabeti. Educazione e culture nella società post-mediale*. Scholé.
- Robinson, N. B., & Soto, G. (2021). AAC in schools: Mastering the art and science of inclusion. *Augmentative and alternative communication: Challenges and solutions*, 81-116.
- Saini, R., & Kumar, S. (2026). The Transformative Role of Assistive Technology in Inclusive Education. *Accessibility Pathways: Inclusive Education for All*, 195.
- Wheeler, M. (2019). *Breaking the Waves: Beyond Parity and Complementarity in the Arguments for Extended Cognition*. In M. Colombo, E. Irvine, & M. Stapleton (Ed's) *Andy Clark and his critics*. Oxford.
- Williams, K., & Holyfield, C. (2025). Future of AAC technologies: priorities for inclusive innovation. *Augmentative and Alternative Communication*, 41(3), 211-214.
- Yoder, D. E., & Kraat, A. (1983). *Intervention issues in non-speech communication*. In J. Miller, D. Yoder, & R. Schiefelbusch (Eds.), *ASHA Reports 12: Contemporary Issues in Language Intervention*.