Journal of Inclusive Methodology and Technology in Learning and Teaching
ISSN 2785-5104
Anno 6 n. 1 (2026)

Edizioni Universitarie Romane
editoria scientifica dal 1952

Networked learning: foundations for a pedagogical theory of situated cognition

Simona Iannaccone [1]

[1] University of Pegaso; simona.iannaccone@unipegaso.it

Abstract: Pedagogy, as the science of education, finds itself as the main actor in the dynamic and complex context where learning is not reduced to mere memorization of concepts, but also involves the development of transversal skills. Studies on situated, distributed, and extended cognition show how human thought is inseparable from the tools and social networks that support it (Anufrieva et al., 2025). Situated learning therefore seems to offer an effective solution both in the field of professional training and in school education, and it is within this space that the contribution aims to explore the relationship between network-mediated learning and the theory of situated cognition. Situated cognition, a theoretical approach initially developed by Lave and Wenger and later expanded in a modern key, maintains that learning is closely related to the context in which it takes place and that knowledge develops through active involvement in authentic practices and within "communities of practice," where students learn by participating actively and negotiating meanings with others (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991). It is precisely here that the close connection between networked learning and the theory of situated cognition is created: the internet has created a new environment characterized by interactivity and unlimited access to information, thus promoting the emergence of "virtual communities of practice." This is an environment that is by its nature "situating" and that offers opportunities to contextualize learning and make it authentic (Li, 2025).

Keywords: situated cognition; networked learning; digital cognitive artifacts; learning environments; digital pedagogical

1. Introduction

The digital transition of recent years has profoundly redefined the boundaries of learning and cognition. As highlighted by Zou et al. (2025), "the integration of digital technologies in education represents a significant evolution in the pedagogical landscape." This transformation has prompted pedagogical and neuroscientific debate, emphasizing the urgency of developing educational models capable of overcoming the historical dichotomy between theory and practice, and of promoting experiential, relational, and reflective forms of learning. The extraordinary spread of mobile devices, collaborative platforms, the Internet, artificial intelligence, and the continuous emergence of new technologies have radically transformed the world and the way we live. Educators, too, recognize the pedagogical implications of artificial intelligence, underlining the importance of its regulated and conscious use: "teachers have an overall positive perception of the ethical and pedagogical use of artificial intelligence... but highlight the need to regulate and understand its implications" (Aljabr & Al-Ahdal, 2024).

The capacity of the Internet to make information widely accessible has profound implications for education: "digital technologies have brought changes in the nature and scope of education," pushing educational systems to rethink teaching and learning strategies and policies (Timotheou et al., 2022). Despite the pervasiveness of the Internet in everyday life, gaps and critical issues remain in the conscious and responsible use of the web. In fact, learning through the web does not simply mean using the Internet as a source of endless information, but rather being able to immerse oneself in a complex cognitive ecosystem made up not only of information, but also of interactions, digital identities, and intelligent environments. It is therefore essential, also to help educators and teachers keep up with the times, to develop a pedagogical theory that provides guidelines connecting learning, context, and digital media.

To deepen the theoretical framework related to the interaction between human beings and digital technologies, it is essential to clarify both components involved in this interaction: the cognitive system and the environment. The definition of the cognitive system varies depending on the theoretical paradigm of reference. In the classical approach, cognition is seen as a sequential process divided into phases of encoding, processing, and storing information. In this model, cognitive activity is confined within the central nervous system, meaning it is limited by the physical boundaries of the human body, such as the skull and skin (Rupert, 2009). Conversely, more recent perspectives—such as situated, embedded, extended, and embodied cognition—drawn from the theory of extended cognition, conceive cognition as a process distributed over time, in space, and closely tied to context (Wilson, 2002). According to this view, the cognitive system is not isolated but interacts dynamically with the surrounding environment, thereby extending its boundaries beyond the organism itself. Despite the criticisms raised regarding the nature and actual influence of the environment on cognition (Rupert, 2009; Smart, 2017), the literature supporting situated cognition is continuously expanding (Anufrieva, A., et al. 2025; Casper & Artese, 2023).

The environment can be understood as the set of elements and conditions which, by changing, influence the functioning of a system in relation to them (Ackoff, 1971; Wilson, 2002). The environment thus includes social aspects, physical characteristics, and cultural tools, also known as cognitive artifacts (Card, 2018; Norman, 1991). According to Norman (1991), a cognitive artifact is "an artificial device designed to maintain, display, or operate upon information in order to serve a representational function." These artifacts include very different tools, such as calculators, checklists, written notes, books, diaries, calendars, and so on (Norman, 1991). Cognitive artifacts can take many forms (Zhang & Norman, 1995). This variety becomes even more significant in the case of digital cognitive artifacts, which include devices such as computers, smartphones, and tablets, as well as software and applications (Falikman, 2021; Kleineberg & Boguñá, 2015). As a result, digital artifacts not only differ from one another but are also characterized by remarkable variability, making it difficult to compare them with their physical counterparts or to analyze effects attributable solely to the digital realm.

There is an ongoing debate about the role of artifacts in cognitive processes: whether they merely support the process or are capable of constituting it, amplifying certain aspects, reorganizing the entire system, or simply enhancing it through cognitive offloading (Card, 2018; Floridi, 2014). Numerous philosophical approaches have proposed principles and ideas about the relationship between the cognitive system and artifacts. Among the most relevant are distributed cognition (Risku & Rogl, 2020) and extended cognition (Wilson & Clark, 2006). These approaches share a tendency to blur the boundaries of the cognitive system by including surrounding cognitive artifacts in human activities or extending those activities to the artifacts themselves. However, the degree of inclusion or extension, as well as the modality, varies. The aforementioned approaches imply a close interaction between cognition and the environment, particularly with cognitive artifacts. However, the nature of this interaction remains a central issue.

Although at first glance devices such as smartphones, tablets, and computers may also fall under this definition, Norman (1991) specifies that digital cognitive artifacts require an interface that makes information understandable to the human user. This interface is defined as the surface level of the artifact's representation. In the case of a written page, for example, the paper medium itself serves as the interface, offering stable and directly accessible symbols. It is precisely this surface representation that constitutes the point of contact between the artifact and the user, as it provides signs and symbols that are easily interpretable.

In digital systems, however, there is also an internal level of representation, consisting of codes and structures that are not immediately accessible or interpretable by the average user. For this reason, it is not the entire device that is considered a cognitive artifact, but only the interface of a specific software, website, or application. Moreover, unlike physical artifacts, digital ones present high plasticity: they are less stable but more adaptable and modifiable (Kallinikos et al., 2013).

As already noted, the concept of cognitive artifact can take very different forms and meanings (Zhang & Norman, 1995). This variety becomes even more significant in the digital context, where not only physical devices like computers, phones, or tablets are included, but also immaterial components such as applications and software (Falikman, 2021; Kleineberg & Boguñá, 2015). A further challenge is posed by the continuous evolution of the digital environment: improvements at the hardware level (e.g., hard drives, displays) bring with them an expansion of software possibilities, both in terms of functionality and interfaces (Shalf, 2020).

However, digital artifacts not only present themselves in a variety of forms, but are also extremely dynamic. This combination of heterogeneity and variability makes direct comparison with material artifacts complex and hinders the analysis of effects that can be exclusively attributed to digital cognitive artifacts.

2. Theoretical and educational foundations of situated cognition

The origins of situated cognition can be traced back to the thought of John Dewey, considered one of the main forerunners of this theoretical perspective. He developed a conception of learning centered on experience, according to which cognitive processes cannot be understood separately from the social, cultural, and practical contexts in which they take place. Knowledge is not seen as a set of abstract mental representations, but as something that emerges from the interaction between the individual, activity, and environment, and is constructed through participation in shared social practices.

In the classical approach, cognition is considered a sequential process articulated in phases of encoding, processing, and storing information, and is confined within the limits of the central nervous system—that is, within the physical boundaries of the human body (Rupert, 2009). For Dewey, knowledge does not derive from a mere passive transmission of information, but is built through a continuous and dynamic interaction between the subject and the surrounding environment (Dewey, 1938). For education to be genuinely meaningful, it must begin with concrete and relevant problems for the individual, promoting the principle of *learning by doing*. Authentic educational experience also involves a reflective process that allows the subject to assign meaning to their actions and to reorganize lived experiences (Dewey, 1938).

These assumptions clearly anticipate the idea, central to situated cognition, that learning is inextricably linked to the context and to the practical activities in which it takes place.

Another key concept of the theory of situated learning is that of legitimate peripheral participation, which describes the process by which novices progressively enter a community—initially by observing and performing simple tasks—then gradually moving from marginal to full participation, eventually becoming expert members and mastering the practice. In this perspective, knowledge is inseparable from action and from the social practices in which it is manifested: learning is more effective when it occurs as a social process of active involvement and co-construction of knowledge, rather than as passive acquisition of information.

There is, therefore, no such thing as neutral and decontextualized knowledge, but only situated knowledge, closely tied to the cultural and historical contexts in which it takes shape.

In summary, the key principles proposed by Lave and Wenger include the centrality of context, the conception of learning as active participation, and the close connection between knowledge, action, and social practices. These elements have served as a starting point for further theoretical developments, prompting other scholars to deepen the theory of situated cognition and explore its implications for learning processes.

Brown, Collins, and Duguid (1989), for example, criticized the traditional separation between theoretical and practical knowledge. According to these authors, cognitive skills are always rooted in their contexts of use and in the tools that mediate them; authentic learning occurs when students are engaged in meaningful activities that reflect the real practices of expert communities. This approach contrasts with abstract and decontextualized teaching, instead proposing authentic tasks and realistic situations that promote contextualized learning.

In contrast, more recent cognitive theories—including those of situated, embodied, extended, and embedded cognition—are based on the hypothesis of extended cognition and describe the mind as a dynamic system that develops over time, in space, and in close relation to context (Wilson, 2002). In this view, the cognitive system actively interacts with the surrounding environment, going beyond the physical limits of the body.

Despite some criticisms regarding this interaction (Rupert, 2009; Smart, 2017), there is growing empirical evidence in support of the situated approach to cognition (Anufrieva, A., et al. 2025; Casper & Artese, 2023). Although critical positions exist regarding the interaction between mind and environment (Rupert, 2009; Smart,

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

2017), an increasing number of studies support the effectiveness and validity of the situated cognition approach (Anufrieva, A., et al. 2025; Casper & Artese, 2023).

3. From distributed cognition to extended cognition: the role of artifacts in mental processes

The role that artifacts play in cognitive processes is still a subject of debate: there is ongoing inquiry into whether they merely provide operational support, or whether they are capable of actively participating in the construction of cognition—amplifying certain aspects, reorganizing the overall structure, or enhancing it through the externalization of some mental functions (Card, 2018; Floridi, 2014). Various philosophical orientations and theoretical frameworks have developed different views on the relationship between the cognitive system and artifacts. Among the most significant are the theories of distributed cognition (Risku & Rogl, 2020) and extended cognition (Wilson & Clark, 2006). Both share the assumption of overcoming the traditional boundaries of the mind, proposing the integration of cognitive artifacts into the flow of human activities or the extension of such activities to the artifacts themselves.

However, each model theorizes the extension of cognition in different ways, varying in form, intensity, and criteria of inclusion. In general, these approaches recognize a deep interaction between mental processes and the environment, with particular attention to cognitive artifacts. Nevertheless, the specific nature of this interaction remains a crucial point of investigation. To fully understand these dynamics, it is necessary to examine the main theoretical perspectives that analyze the relationship between human beings and artifacts.

The theory of distributed cognition finds its roots primarily in A. Leont'ev's activity theory and in the historical-cultural perspective developed by Vygotsky (Hutchins, 1995). The core principle of this approach is that cognitive activities can be externally represented and shared among multiple individuals. This shared representation includes the goals to be achieved within a task, facilitating cooperation among actors. Tools—namely, artifacts—act as functional supports for the distribution of information, enabling the emergence of a complex network composed of subjects, activities, and tools. In this context, the cognitive artifact does not merely assist the activity but can modify its course, particularly by redistributing the cognitive resources involved. However, such artifacts are predominantly conceived as performance-support tools. Distributed cognition thus represents one of the fundamental theoretical bases in the field of human-computer interaction and in the sciences that deal with digital and artificial ecology (Kleineberg & Boguñá, 2015). In these domains, digital artifacts are seen as entities that transform and evolve through interaction with the user, while still maintaining an instrumental function aimed at achieving human goals.

According to Donald Norman (1991), the role of cognitive artifacts can be interpreted through two different perspectives: a systemic view and a personal view. In the former, the artifact is considered a means to enhance human cognitive abilities. In the latter, the introduction of the artifact results in an overall transformation of performance, leading to a reorganization of activities, sub-tasks, and actions involved.

In the systemic model, for example, the use of tools such as a notebook or a smartphone to take notes represents an extension of memory capacity. In contrast, from the personal perspective, the use of the artifact directly modifies the sequence and nature of the actions required to complete the task. Consider the case of memorizing a phone number: without an artifact, the typical sequence is "listen – repeat – remember," whereas with the artifact, it becomes "listen – write – consult." In both cases, the role of the interface of the digital cognitive artifact is crucial: it must be designed to guide the user and facilitate task completion.

In parallel, the extended cognition approach proposes a more radical vision, in which the cognitive artifact is not simply an external tool but an essential component of a new hybrid system, where artificial and cognitive elements interact in an integrated manner. In this perspective, the digital system no longer functions as a mere instrument, but becomes an inseparable part of the individual's cognitive reality, equipped with its own functionalities, complexity, and, in some cases, autonomy. This extension enables a reduction of cognitive load and supports the improvement of mental functions (Card, 2018; Wilson & Clark, 2006). The fact that the artifact is not physically connected to the brain does not invalidate its role. Once removed, in fact, the entire integrated system is compromised, since the artifact has assumed a causal function in information processing (Clark & Chalmers, 1998). As a result, cognitive artifacts do not merely support activities—they become constitutive elements of cognition, changing the very way in which information is processed.

In summary, within the domain of distributed cognition and activity-centered design (personal view), the cognitive artifact is conceived as a tool useful for reorganizing action, without implying deep co-dependence or true integration into the cognitive system. Conversely, in extended cognition and activity-centered design seen from a systemic perspective, what is hypothesized is not only reorganization but also enhancement and constitution of cognitive functions, generating an integrated system between human and technology. In essence, on one hand, interaction with the artifact modifies the activities; on the other, it transforms the cognitive functions themselves.

However, despite the theoretical value of these approaches, a clearly defined conceptual framework is still lacking—one that systematically clarifies the mechanisms underlying these processes. As with theories of attention and memory, it is necessary to develop specific models that describe the interaction between cognitive functions and artifacts—whether physical or digital—and that can be empirically tested. These models should also be based on existing theories of cognitive functioning that are independent of the environmental context, as already emphasized by Norman (1991). An important step in this direction is the identification and description of the distinctive characteristics of cognitive artifacts, whether material or digital.

4. Cognition and learning in situated digital environments: pedagogical reflections

The web can no longer be considered solely as an educational tool for consulting content or transmitting information in a one-way manner. It must be rethought in its broader meaning, as a dynamic and constantly evolving social environment, within which cognitive processes and learning modalities develop in a situated, distributed, and culturally mediated form. From this perspective, learning is not an individual and decontextualized phenomenon, but a social practice rooted in specific cultural and relational contexts, as emphasized by the theory of situated learning (Lave & Wenger, 1991).

This vision, now further strengthened by studies on digital learning environments, requires a deep revision of traditional educational paradigms. According to Dillenbourg (2016), digital learning environments constitute true educational ecologies, in which technology, pedagogy, and social interaction intertwine systemically. Within the adopted theoretical framework, the web cannot simply be defined as a context for learning but must be recognized in its transformative pedagogical function as a situating environment—that is, a context that significantly affects the ways in which knowledge is constructed and educational practices are shaped.

For such an approach to be concretely applied, it is necessary that the actors involved in the educational process—teachers, trainers, and educators—be willing to undertake a critical reflection on the methodological and pedagogical implications it entails. Learning in complex digital contexts requires specific preparation and a radical rethinking of the relationship between the individual and technologies. Within this framework, the learner is no longer a passive recipient of content but becomes an active subject in the construction of knowledge, a true epistemic agent involved in meaning-making processes within communities of practice (Wenger, 1998).

One of the most significant consequences of this transformation concerns the weakening of traditional distinctions between formal, non-formal, and informal learning. Digital technologies contribute to creating continuity across different educational contexts, making the boundaries between school, work, and daily life increasingly permeable (Eraut, 2004). In this sense, recent international educational policies emphasize the importance of lifelong learning ecosystems, highlighting how digital learning fosters connections among diverse educational settings (OECD, 2021). This gives rise to an intermediate space that underscores the need to develop innovative pedagogy, capable of recognizing, connecting, and valuing the multiple learning experiences that occur beyond conventional frameworks.

With regard to instructional design, when it is oriented toward networked learning integrated with digital and cognitive technologies—particularly in light of the 4E Cognition theory (embodied, embedded, enacted, extended) (Newen, A., De Bruin, L., & Gallagher, S., 2018)—it undergoes a profound transformation. Digital environments are no longer mere containers of information, but are configured as intelligent educational spaces in which digital technologies act as active mediators of cognitive processes. In this sense, mental processes are not confined within the individual but extend into the environment and the technological artifacts that surround them (Clark & Chalmers, 1998), contributing to a cognition that is distributed among people, tools, and contexts (Hutchins, 1995). More recent studies confirm that cognition emerges from the dynamic interaction between mind, body, environment, and culture (Newen, De Bruin, & Gallagher, 2018).

Therefore, online instructional design cannot reduce technologies to mere supports. Participants in the educational process must recognize that digital artifacts shape thought and influence learning modalities; that the social and technological network constitutes a structural component of the educational ecosystem; and that the instructional design becomes the result of co-design between human and non-human actors (students, teachers, tools, and context). As Salomon (1993) highlighted, technologies are not neutral tools, but transform the cognitive processes they support.

Secondly, it is essential to overcome linear transmissive models, in which the teacher explains and the student passively receives information. Instead, priority should be given to the creation of authentic and interactive environments, capable of promoting learning based on collaborative problem-solving and the shared construction of knowledge. Recent literature on digital learning shows that collaborative and inquiry-based approaches foster greater cognitive depth and meaningful learning (Kovanović et al., 2015; Holmes et al., 2019). To achieve this goal, learning objectives must be reformulated, shifting from the simple possession of technical skills to the acquisition of complex and contextualized digital competences.

According to Murri and Patera (2025), effective instructional design in online learning contexts must promote competent digital action, understood as the ability to use technologies in a situated, meaningful, and relational way, integrating cognitive, social, and motivational dimensions. This approach implies that instructional design cannot be limited to the selection of platforms and digital tools, but must be directed toward the overall quality of the educational experience, defining articulated objectives that are coherent with the complexity of the digital environment.

From this perspective, methodologies such as problem-based learning, project-based learning, inquiry-based learning, e-learning, and blended learning prove particularly effective. These approaches promote flexible, customizable, and accessible forms of learning, allowing students to autonomously explore available resources and experiment with learning strategies aligned with their own inclinations. An additional advantage of this approach is the growth of personal autonomy and student responsibility, encouraging learners to manage their own learning process according to rhythms and methods consistent with their individual characteristics.

5. Conclusions

The analysis conducted in this contribution has highlighted how networked learning should not be considered merely a technological tool, but rather a situating environment in which cognitive processes, social relationships, and cultural practices intertwine in a dynamic and complex way. In line with classical theories of situated cognition, according to which knowledge emerges from active engagement in social practices (Lave & Wenger, 1991), the contemporary digital ecosystem promotes contexts in which digital cognitive artifacts—devices, interfaces, and applications—become structural elements of knowledge construction, capable not only of supporting but also of shaping cognitive functions and social interactions (Clark & Chalmers, 1998; Hutchins, 1995).

This transformation has important pedagogical implications. The spread of digital learning environments requires a rethinking of traditional educational models, no longer based on the transmission of content, but on the design of situated cognitive experiences in real or virtual learning contexts. As highlighted by Dillenbourg (2016), digital technologies configure learning ecologies, in which the relationship between technology, learner, and socio-cultural environment is systemic and mutually influential. This perspective goes beyond the idea of technologies as mere supports, introducing them as active mediators in the processes of meaning construction (Salomon, 1993).

Furthermore, recent literature emphasizes the importance of communities of practice and collaborative learning as privileged spaces for the negotiation of meanings and the development of transversal skills (Kovanović et al., 2015; Holmes et al., 2019). These dynamics expand the concept of learning along a continuum that crosses formal, non-formal, and informal settings (Eraut, 2004), requiring a pedagogy capable of valuing the individual's overall experience and recognizing the multiple contexts in which it takes place.

Another critical and reflective issue concerns the role of educators in situated digital environments: the teacher is no longer merely a transmitter of knowledge, but a facilitator of learning experiences, a co-designer of personalized learning pathways, and a mediator of interactions between cognitive artifacts and social practices. This change implies complex professional competences, able to integrate cognitive, social, technological, and ethical aspects, and to guide students toward the conscious use of technologies (OECD, 2021).

Finally, the development of a pedagogical theory of situated cognition in networked learning cannot ignore a critical view of the interaction between the individual and the digital environment. It is necessary to promote an educational orientation that recognizes the importance of designing authentic, interactive, and cooperative environments, capable of stimulating autonomy, critical reflection, and active participation of subjects (Brown et al., 1989). The convergence between advanced cognitive theories (such as 4E Cognition) and digital educational practices allows the web to be viewed not only as a space for information distribution, but as a living context for the collective construction of knowledge, where digital citizenship, ethics, and critical competence become essential dimensions of education in the 21st century (Veletsianos, 2020).

However, networked learning, when interpreted through the lens of situated cognition and digital ecologies, represents not only a response to the challenges posed by digitalization, but also a pedagogical opportunity to redesign educational spaces, processes, and relationships, orienting them toward a situated, reflective, and integrated form of education aligned with the complex contemporary social and technological realities.

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

References

Ackoff, R. L. (1971). *Towards a system of systems concepts*. Management Science.

Aljabr, F. S., & Al-Ahdal, A. A. M. H. (2024). Ethical and pedagogical implications of AI in language education: an empirical study at Ha'il University. *Acta Psychologica (Amst)*, 251, 10460.

Anufrieva, A., et al. (2025). Cognitive digital interaction: the state of the field, challenges and future directions. *Cognitive Digital Interaction Review.*

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42.

Card, S. K. (2018). *The foundations of human–computer interaction*. Cambridge University Press.

Casper, M.-O. (2023). A methodological problem of choice for 4E research. In M.-O. Casper & G. F. Artese (Eds.), *Situated cognition research: Methodological foundations* (pp. 17–43). Springer Nature Switzerland AG

Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis, 58*(1), 7–19.

Dewey, J. (1938). *Experience and education*. Macmillan.

Dillenbourg, P. (2016). *Smart learning environments*. Springer.

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education, 26*(2), 247–273.

Falikman, M. (2021). There and back again: A (reversed) Vygotskian perspective on digital socialization. *Frontiers in psychology*, *12*, 501233.

Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality*. Oxford University Press.

Hutchins, E. (1995). *Cognition in the wild*. MIT Press.

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Kallinikos, J., Aaltonen, A., & Marton, A. (2013). The ambivalent ontology of digital artifacts. *MIS quarterly*, 357-370.

Kleineberg, K. K., & Boguñá, M. (2015). Digital ecology: Coexistence and domination among interacting networks. *Scientific reports*, *5*(1), 10268.

Kovanović, V., Joksimović, S., Poquet, O., Hennis, T., de Vries, P., & Gašević, D. (2015). Exploring communities of inquiry in massive open online courses. *British Journal of Educational Technology, 46*(4), 803–813.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lave, J., Wenger, E. (2006). L'apprendimento situato. Dall'osservazione alla partecipazione attiva nei contesti sociali. Trento, Erikson

Li, Y. (2025). Synergistic mechanism between teachers' technological literacy and TBLT strategies: A situated cognition-based framework reconstruction. *Complexity, 8*(4), 81–87.

Murri, S., & Patera, S. (2025). Attenzione profonda, iperattenzione e "digital divide cognitivo" intergenerazionale, Journal of Inclusive Methodology and Technology in Learning and Teaching, Anno5 n.2

Newen, A., De Bruin, L. and Gallagher, S. (2018) The Oxford Handbook 4E Cognition. Oxford University Press, New York.

Norman, D. A. (1991). *Cognitive artifacts*. In J. M. Carroll (Ed.), *Designing interaction: Psychology at the human–computer interface* (pp. 17–38). Cambridge University Press.

OECD. (2021). *Digital education outlook 2021: Pushing the frontiers with AI, blockchain and robots*. OECD Publishing.

Risku, H., & Rogl, R. (2020). Translation and situated, embodied, distributed, embedded and extended cognition. In *The Routledge handbook of translation and cognition* (pp. 478-499). Routledge.

Rupert, R. D. (2009). *Cognitive systems and the extended mind*. Oxford University Press.

Salomon, G. (1993). *Distributed cognitions: Psychological and educational considerations*. Cambridge University Press.

Shalf, J. (2020). The future of computing beyond Moore's Law. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *378*(2166).

Smart P. Extended Cognition and the Internet: A Review of Current Issues and Controversies. Philos Technol.

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2022). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies.*

Veletsianos, G. (2020). *Learning online: The student experience*. Johns Hopkins University Press.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.

Wilson, R. A., & Clark, A. (2006). Situated cognition: Letting nature take its course.

Wilson, R. A. (2002). *Boundaries of the mind: The individual in the fragile sciences*. Cambridge University Press.

Zhang, J., & Norman, D. A. (1995). A representational analysis of numeration systems. *Cognition*, *57*(3), 271-295.

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: Trends, challenges, and innovations in technology integration. *Frontiers in Education, 10*, 1562391.