Smart School As An Ecosystem For The Evolution Of Pedagogical Thinking

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Abstract

This study examines the Smartschool platform developed by the University of Cartagena (Universidad de Cartagena) and the Colciencias institution, as a digital environment that promotes new ways of pedagogical thinking. It was a qualitative interpretative analysis of the platform's functional, aesthetic, and symbolic structure, allowing for the description of different aspects that transcend its technical utility to configure it as a complex educational ecosystem. The research is based on theories such as the extended mind, distributed cognition, imaginative pedagogy, and cultural evolution, from which the digital environment is interpreted as a cognitive and cultural mediator. The results show that Smartschool enhances teaching and learning experiences centered around autonomy, narrativity, and flexibility, but at the same time, poses ethical and formative challenges for 21st-century teachers. In conclusion, a critical understanding of these platforms is key to their meaningful integration into current educational contexts.

Keywords: educational platforms, pedagogical thinking, extended mind, digital pedagogy, imaginative learning, Smartschool.

Introduction

Learning environments have achieved considerable progress thanks to the combination of digital technologies, new learning epistemologies, and the relevance of adaptable and flexible pedagogical models (Bidarra & Rusman, 2017). Not only have they modified school practices, but they have even changed the very ways of thinking about education to the point of giving it a consideration that could be thought of as a mutation in pedagogical thinking (Weller, 2022). For this purpose, learning management systems (LMS) are not merely technical tools, but constitute symbolic ecosystems that integrate other cognitive, cultural, and social dynamics.

An example of this is Smartschool, which is a platform that emerged within the framework of a collaborative project between the University of Cartagena (Universidad de Cartagena) and the Colciencias institute, whose purpose is to offer teachers, students, and administrators a dynamic environment for personalized teaching and learning. The analysis of platforms such as Smartschool from a cultural and evolutionary perspective allows for pointing out that they can be conceived not only as tools, but as extensions of the mind and the social environment. As Clark and Chalmers (1998) point out through their theory of the extended mind, indicating that digital technologies can be interpreted as human cognitive processes, in whose explanation they appear as symbolic prostheses of memory, reasoning, or representation.

In the case of Smartschool, its structure and functions allow for seeing how new forms of pedagogical thinking are materializing, guided by the logic of adaptability, interactivity, and autonomy. Moreover, from a certain evolutionary perspective, human beings have developed cultural tools to mediate learning long before writing or the formalization of schooling (Lantolf & Poehner, 2023). Digital educational platforms represent a recent phase in this historical framework that can be analyzed from the theories of cultural evolution (Richerson & Boyd, 2008; Legare, 2019), which argue that teaching-learning processes are adaptive processes, socially constructed to bring complex information to subsequent generations.

In this sense, Smartschool can be interpreted as a cultural response to the current challenges of education, whose design has not only informative functions, but also normative and educational ones: it regulates times, behaviors, learning styles, and forms of interaction between different educational actors. Similarly, the idea of pedagogical imagination, developed by Kieran Egan (1997), is important to account for the symbolic potential of the platform. According to Egan, teaching consists of applying imaginative resources that articulate knowledge and the narrative, emotional, and sensory structures of human thought. Smartschool, as a digital ecosystem, provides visual, narrative, and interpretive resources that can be understood as ways to activate the imagination of

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the teacher who creates and of the student who explores and constructs knowledge.

Therefore, this article aims to study how Smartschool, as a digital ecosystem, represents a breakthrough in pedagogical thinking by articulating technological, cognitive, and cultural dimensions that reshape the way we understand teaching. Through an interpretive qualitative approach, the platform's structures, functions, and discourses are explored from a symbolic perspective, without resorting to direct fieldwork, but with active access to its navigation environments. The objective is to verify how the design and organization of Smartschool shape pedagogical practices consistent with contemporary cultural patterns, configuring new forms of representation, interaction, and agency in the digital classroom.

Methodology

This work is classified within a qualitative perspective with an interpretive orientation (Sánchez & Murillo, 2021), since it seeks to understand how the Smartschool platform articulates and supports contemporary ways of pedagogical thinking in the educational context of Colombia. On the other hand, since the objective is to explore cultural and symbolic meanings, impacts are not evaluated, nor are correlations that can be quantified established (Herrera, 2017). This explains the choice of a hermeneutic approach, supported by structured observation, functional analysis, and a reflection on the types of discourses of the contexts that make up the platform (Rennie, 2012).

The analysis was conducted through direct access to Smartschool, enabling an internal exploration of the interface, navigation, and available features. This allowed for a non-intrusive and respectful approach that did not necessarily depend on the participation of platform users or the collection of personal data. Instead, the approach was to develop a structured observation proposal based on the following units of analysis:

1) Teacher environments: content creation tools, task management tools, feedback tools, visual resources, curriculum organization methods, and student progress monitoring.

2) Student spaces: forms of interaction, autonomy in learning, personalization of the educational journey, visual and narrative stimuli.

3) Communicative elements: button language, menus, interface messages, instructions, and system descriptions.

4) Functional and symbolic design: visual layout of the platform, navigation routes, iconography, hierarchical structures, and modes of knowledge representation.

Each of the interface components was documented with screenshots, detailed descriptions, and interpretive annotations above the screenshots, allowing for a detailed analysis of the cognitive and cultural structures with which the interface's design characteristics for teaching are intertwined. Particular attention was paid to the way the interface guides pedagogical activity, the kind of relations it creates with respect to the actors involved in the educational process, and the conception of learning embedded in its resources and functionalities.

The analysis was guided by the principles of the hermeneutic method, because the platform is considered a technological text that can be interpreted based on the conceptual categories that were previously discussed: the extended mind (Clark & Chalmers, 1998), the cultural evolution of learning (Richerson & Boyd, 2008; Legare, 2019), and the pedagogical imagination (Egan, 1997). These categories allowed for establishing relations between the technical configuration of Smartschool and the pedagogical models it promotes, understanding that every technological design incorporates a vision of the world, the mind, and culture.

This methodology, although limited to the analysis of the digital environment itself, offers a legitimate and fertile venue for qualitative inquiry, insofar as it recognizes the symbolic power of educational technologies as cultural and cognitive agents. In this way, the study seeks not only to describe the functioning of Smartschool, but also to understand its role in the evolution of teaching practices, the reorganization of school discourses, and the configuration of new forms of educational subjectivity.
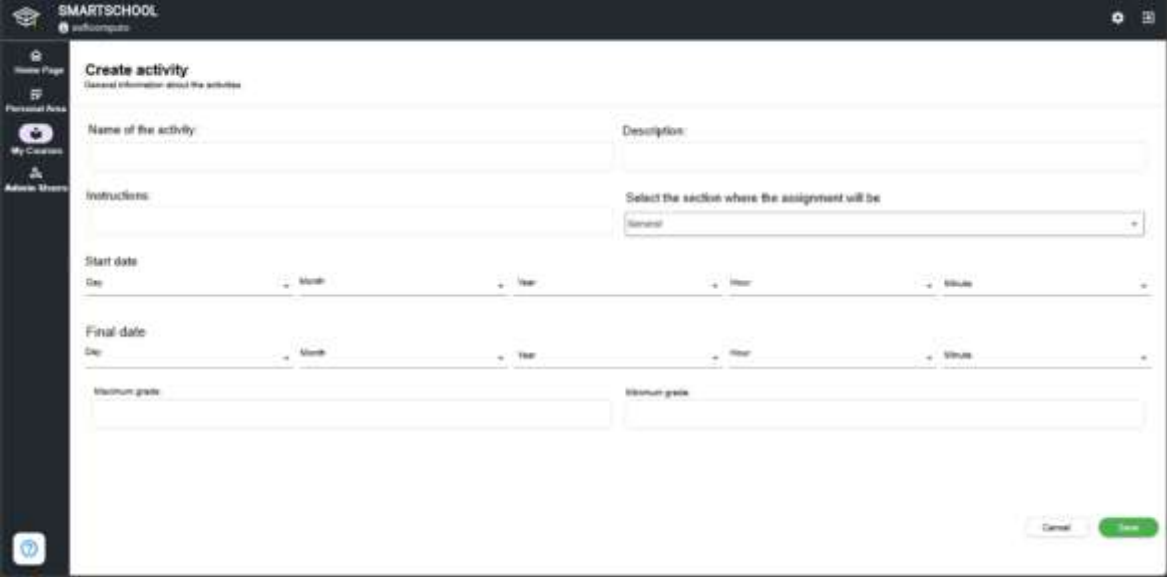
Results

A comprehensive evaluation of the Smartschool platform, carried out through structured observation and symbolic analysis of its digital environments, has facilitated the identification of four major dimensions that contribute to determining the platform's role as a developing and evolving pedagogical ecosystem. These dimensions were present in the design of the platform's functionality and in the discourse it transmits, giving rise to the following: (1) the flexibility of the teacher's role; (2) autonomy and navigation as the core of the student experience; (3) the symbolic reconfiguration of the classroom; and (4) the imagination linked to the pedagogical design process. Each of these categories is addressed below.

1. Flexibility of the teacher's role

One of the most relevant findings relates to how the platform transforms the role of the traditional teacher. Once the platform becomes familiar with the educator's environment, it is possible to identify an environment and architecture geared toward pedagogical design rather than simply transferring content. Teachers can structure courses and activities as module sequences, adjust learning paths based on the student's level, prepare automatic or open assessments, and customize feedback functionality with multiple audiovisual resources, among other features, as seen in Figure 1. These options not only increase the educator's agency but also position them as curators and architects of knowledge, rather than as the sole transmitter.

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Figure 1. Architecture aimed at pedagogical design (activity creation)

Source: Authors

This flexibility facilitates a pedagogical thinking model in which technology is understood as an extension of teaching planning, allowing for iteration, adaptation, and experimentation with different pedagogical strategies. In this logic, interface design functions as a useful means to expand the teacher's creative and projective capacity, an aspect consistent with Clark and Chalmers' (1998) notion of the extended mind. At a symbolic level, this structure distances the teacher from the authoritarian figure focused solely on control, favoring a transition toward a more horizontal figure, in which the teacher acts as a manager of learning environments and possibilities rather than as a transmitter of closed content.

Furthermore, as shown in Figure 2, the platform allows teachers to monitor attendance. Systematic teacher monitoring, through mechanisms such as attendance monitoring and early warnings, allows for the identification of risk signals in students. This enables the implementation of timely interventions aimed at preventing school dropouts and promoting greater student retention.

Figure 2. Attendance control mechanism and early warnings of absenteeism
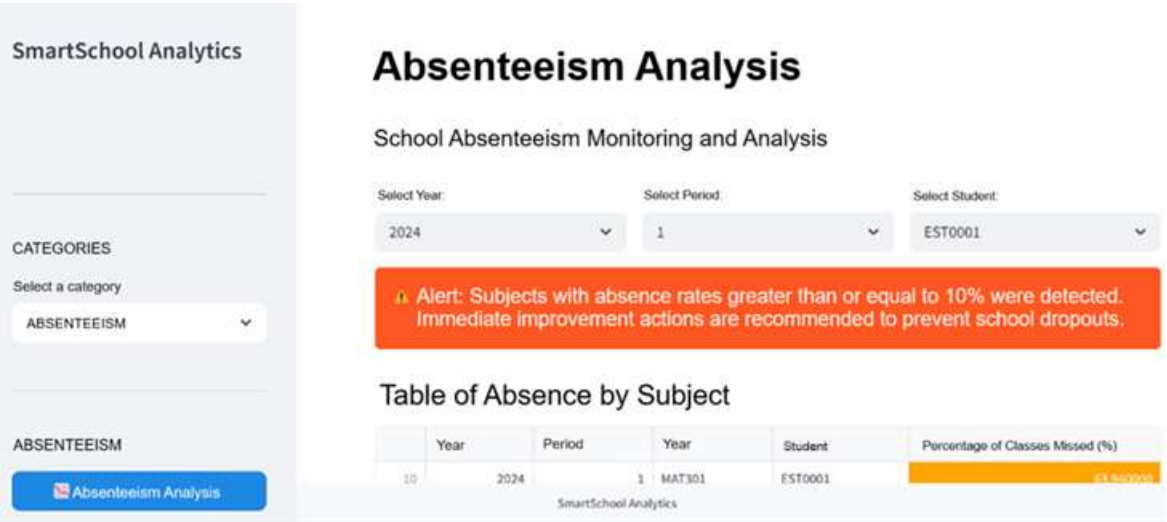
Source: Authors

The Smartschool platform interface, as shown in Figure 3, also features a set of tools for analyzing student absenteeism. These functions range from analysis of absence and attendance to more specific assessments by subject, group, grade, and institution. It also includes sections dedicated to identifying causes and corrective actions, as well as personalized and comparative analyses, allowing teachers or management teams to adapt their strategies to different contexts. Of particular note is the "Dropout Prediction" feature, which, through

the use of predictive algorithms, allows for anticipating potential cases of school dropouts. This structure not only supports data-driven decision-making but also

reinforces the preventive and personalized approach to pedagogical support promoted by the platform.

Figure 3. Tools for analyzing student absenteeism

Source: Authors

2. Autonomy and navigation as the core of the student experience

At the student level, Smartschool proposes autonomous and modular navigation scenarios, differentiating itself from closed models where progression depends on rigid and homogeneous sequences. At the same time, it allows students to progress at their own pace, carry out activities as many times as necessary, explore alternative paths,

and receive and experience continuous feedback (visual, textual, audio). As can be seen in Figure 4, from this perspective, the design of this software can be considered not only as a set of technical functions, but a cultural model of learning: the student is configured as an active subject capable of making decisions, self-regulating, and building their learning paths based on their interests and rhythms.

Figure 4. Student environment of the Smartschool platform

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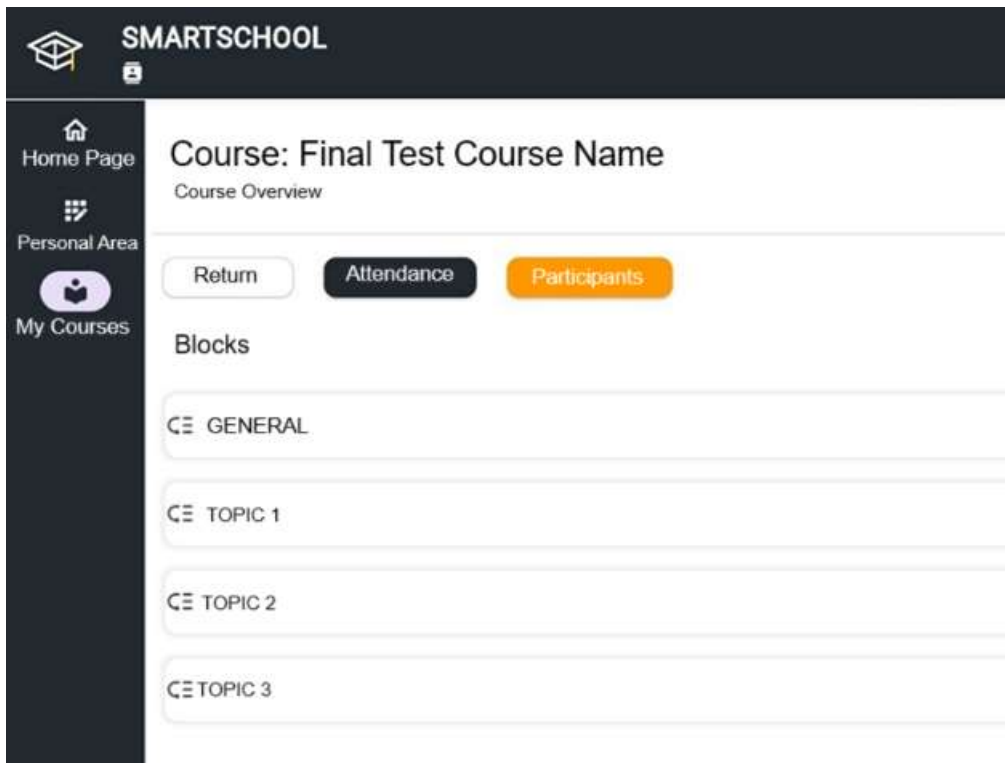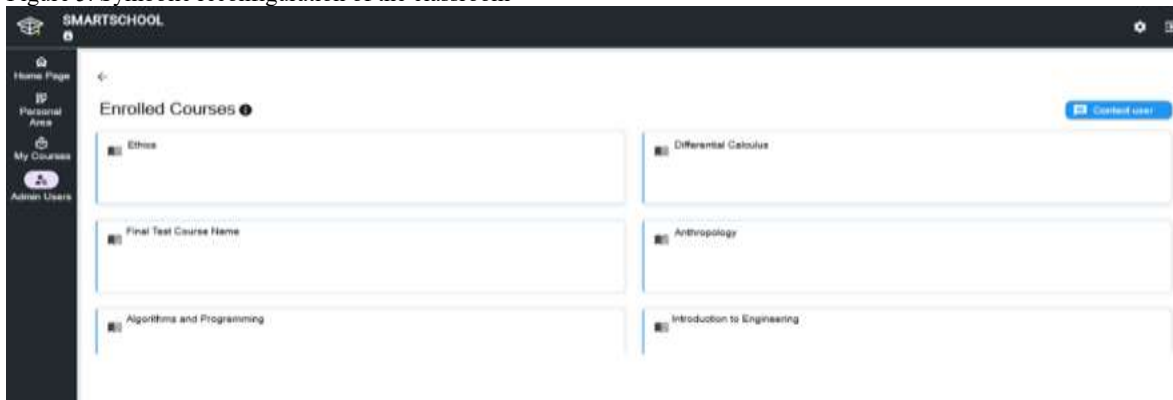
Source: Authors

Furthermore, gamification elements (badges, levels, progress indicators) and self-review tools create a logic of self-assessment and metacognition, essential elements of current student-focused education models. The exchange of visual, audio, and textual materials is the appropriate way to accommodate cognitive diversity; from the perspective of cultural evolution, this could be considered an adjustment of the educational space to the new ways of managing information among digitally literate generations. Furthermore, the interface symbolically suggests that knowledge is not linear or hierarchical but rather a field of exploration that is navigated, questioned, and inhabited, promoting an active and personalized relationship with knowledge.

3. Symbolic reconfiguration of the classroom

One of the most profound transformations proposed by Smartschool is the reconceptualization of the classroom. By relocating the learning environment to the digital space, new logics of interaction, distribution, and temporality emerge. The classroom is no longer a closed space where what happens synchronously occurs, but an open, flexible space where the educational relationship occurs asynchronously, in a distributed manner, and in multiple formats.

This is evident, as seen in Figure 5, in the layout of courses and forums, collaborative tasks, co-creation tools, and resources available at all times; that is, in the entire set of elements that ultimately blur the idea of a class as a single event in a given period. Instead, a permanent, mobile, and personalized pedagogical experience emerges, facilitating constant and adaptive interaction.

Figure 5. Symbolic reconfiguration of the classroom

Source: Authors

Symbolically, this transformation represents a cultural evolution of the school space: from the physical architecture of the classroom to a symbolic architecture, built from information flows, nodes of interactivity, and shared cognitive experiences. The hierarchy that traditionally allows for the establishment of a distinction

between teacher and students also becomes less noticeable, as can be seen in Figure 6, since both share tools and environments that force them to negotiate meanings and commitments in the constitution of knowledge.

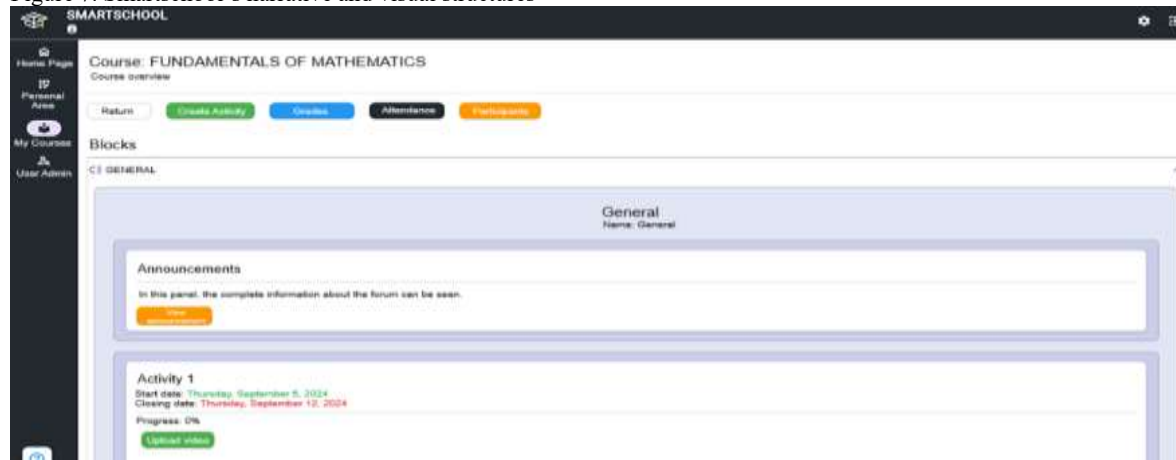Figure 6. Cultural evolution of the school space
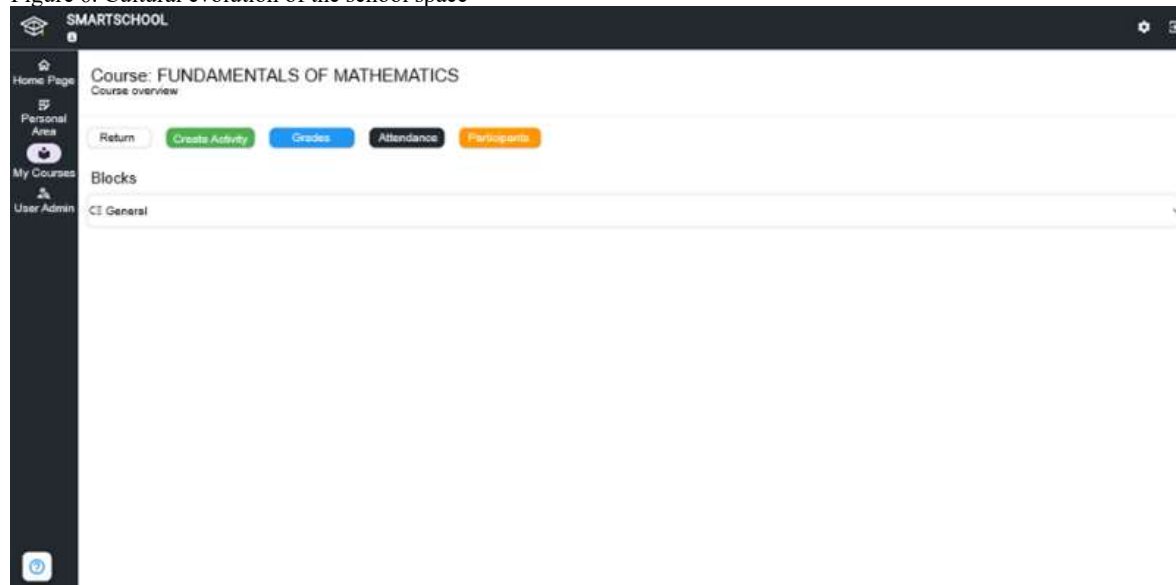
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4. Imagination as a design principle

Finally, the element that somehow unites the entire Smartschool's experience is the presence of narrative and visual structures designed to stimulate the imagination. From the icons to the organization of content, including the possibility of incorporating interactive stories, simulations, or transmedia resources, the platform offers a way of teaching that invites students to imagine, represent, and emotionally connect with the content.

Along these same lines, as can be seen in Figure 7, the interface of the "Fundamentals of Mathematics" course exemplifies how this visual and narrative structure is realized: colors differentiated by function, intuitive buttons, and a hierarchically organized overview panel, facilitate fluid navigation, where activities, grades, attendance, and notifications can be viewed clearly and accessibly. This layout not only improves the user experience but also fosters a more dynamic and meaningful learning environment.

Figure 7. Smartschool's narrative and visual structures

Source: Authors

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Thus, this aesthetic and symbolic dimension is not merely decorative, but has an important cognitive and pedagogical function. In Kieran Egan's (1997) formulation, imagination is an evolutionary instrument that enables what he calls a conjunction of emotion, memory, and intuition in learning. The Smartschool platform bends this logic so that students not only receive information but also experience it. Teachers, in turn, can articulate paths that foster internal narratives, metaphorical connections, and complex symbolic constructions. It is not, therefore, a simple content platform, but a stage for pedagogical thought in which each resource and each feature is important in transforming the relationship with knowledge in a specific way.

Discussions

The conclusions of this work lead to a profound reflection on the role that digital platforms can play in transforming the pedagogical models in use today. In the case of Smartschool, it is clear how its symbolic and technical structure transforms into an educational proposal that aligns with the pedagogical proposals that define principles of cultural evolution, the extended mind, and pedagogical imagination, and which encompass not only new ways of teaching but also new ways of thinking about education in the broadest sense of the extension of education. The results are interpreted below.

1. Technology and the extended mind: from tools to distributed thinking

Based on the theory of the extended mind (Clark & Chalmers, 1998), it is argued that technological artifacts do not simply amplify cognitive capacities, but can become an active part of thought. In this sense, Smartschool cannot be interpreted solely as a tool to support education, but can be considered a cognitive system where both students and teachers think, plan, create, and learn. Its functional design enables a form of distributed cognition (Hollan et al., 2000), where the interface acts as a semiotic agent that structures pedagogical possibilities.

The way teachers design sequences, organize content, or configure assessments does not respond to a logic external to the platform, but rather emerges from the dialogue between the pedagogical intention and the possibilities (Gibson, 2014) that the system offers. Thus, teaching with Smartschool is not the same as transferring pre-existing content to a new medium; it is a practice that redefines pedagogical thinking based on the available symbolic and functional resources, in line with what Largou & El Guermat (2024) propose regarding the cultural internalization of digital tools.

2. Cultural evolution of learning and plasticity of educational environments

Cultural evolution, as addressed by Richerson & Boyd (2008) and Legare (2019), emphasizes that human practices are transformed through the accumulation and transmission of cultural innovations. Education, as a social practice, is not exempt from this dynamic. In this context, Smartschool represents a cultural adaptation of the teaching-learning environment to the demands of a digitally mediated society, characterized by multichannel, asynchrony, and flexibility.

The system not only redefines classroom time and space, but also incorporates new forms of educational socialization. The modular structure, the constant availability of content, asynchronous interactivity, and personalized navigation represent cultural mutations of the traditional school model. These mutations reflect functional needs but also profound changes in the cognitive, communicative, and affective practices of new generations. In line with what Greenfield (2009) proposed, these transformations reflect an evolution of cognition in response to the screen-mediated environment, which poses new challenges for pedagogy.

3. Autonomy, agency and pedagogical subjectivities

Student autonomy, actively promoted in Smartschool, can be understood in terms of learner-centered education, a movement supported by research such as Weimer (2013) and Cornelius-White (2007), which advocates for educational spaces in which students are very active, reflecting on their learning and taking responsibility for themselves. By not restricting self-management of time, allowing non-linear access to completed content, and never ceasing to provide feedback, the platform designs the experience in such a way that students not only learn but also build metacognitive, self-regulatory, and socio-emotional skills.

However, it is important to keep in mind that autonomy is not neutral. As Biesta (2015) points out, all educational architecture implies a specific notion of the subject. In this case, Smartschool constitutes an educational subjectivity centered on productivity, individual exploration, and the logic of merit. The structure of the badges, levels, and rewards that the platform encourages, while certainly motivating in nature, can also be configured within what Foucault (1977) identified as technologies of subjectivation: the mechanisms that guide actions and ways of thinking based on regimes of self-assessment and symbolic control (Kelly, 2013).

4. Imagination as a structuring axis of learning

One of Smartschool's most distinctive contributions is the incorporation of visual, narrative, and symbolic elements aimed at stimulating imagination. This dimension, often relegated in discourses on educational technology, takes on a central role here. According to Egan (1997), imagination is not opposed to rationality, but rather a higher form of cognition that allows for connecting emotions, mental images, and cultural structures in our understanding of the world.

The presence of simulations, narrative worlds, visual metaphors, and playful interfaces in Smartschool reveals the possibility of understanding learning from an aesthetic experience. This aesthetic cannot simply imply

an attractive design; it is also a way of constructing meaning, of articulating meanings that connect with the student's subjectivity and foster processes of deep understanding. In this sense, the platform also responds to proposals such as that of Eisner (2003), who advocates artistic education as a path to a more sensitive, integrative, and critical pedagogy.

5. Challenges and limitations: technology, equity and contextualization

While the results demonstrate transformative potential, it is also necessary to acknowledge the limitations and risks that implementing platforms like Smartschool entails. Unequal access to connectivity, teacher training in digital environments, and the need for constant pedagogical support are factors that determine the effectiveness of these initiatives. As Selwyn (2016) and Williamson (2017) warn, educational technology is not neutral and presents political, economic, and epistemological interests that can reinforce inequalities if not managed critically.

Likewise, the platform's flexibility can become a burden for students with less cultural capital and limited family support. Therefore, the use of environments like Smartschool requires ethical and institutional reflection on their implementation, accompanied by public policies that guarantee access, equity, and ongoing training.

Conclusions

The interpretative exploration of the Smartschool platform as an ecosystem for the evolution of pedagogical thought has allowed for identifying various dimensions that place it in a space beyond the constitution of a technical tool, since it is a symbolic, cultural and cognitive space that redefines the relation between teaching, learning and technology; a pedagogical proposal that, based on its structural functionality and its narrative aesthetic, articulates teaching flexibility, student autonomy, redefinition of the classroom space and a pedagogy of imagination.

This qualitative study, based on structural and symbolic analysis of the interface, allows for concluding that the true value of platforms like Smartschool is not the technological development aimed at digitizing content, but rather the advancement toward new learning ecologies. From the perspective of the extended mind, cultural evolution, and the pedagogy of imagination, it is argued that this platform represents a step toward modalities of pedagogical thought that are more reflexive, more adaptive, and more transitional to the needs of a complex digital culture.

The implications of these findings are significant. First, they suggest the need to train teachers not only in the technical use of these platforms but also in the development of projective, narrative, and critical skills that enable them to design meaningful experiences in digital environments. Second, they reaffirm the importance of considering educational platforms as cultural constructs that convey specific visions of

knowledge, the subject, and the educational connection. Finally, they call on developers, institutions, and public policymakers to consider pedagogical design as a key factor in the equity and quality of digital learning.

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