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INSIGHTFUL ATTENTION ENGINEERING, DIGITAL CULTURE, AND LEARNING: CONTEMPORARY CHALLENGES FOR BASIC EDUCATION

ENGENHARIA PERSPICAZ DA ATENÇÃO, CULTURA DIGITAL E APRENDIZAGEM: DESAFIOS CONTEMPORÂNEOS PARA A EDUCAÇÃO BÁSICA

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ABSTRACT

The intensification of digital culture and the increasing presence of technologies in the daily lives of children and adolescents have brought about significant changes in the ways individuals learn and construct knowledge. In this context, insightful attention engineering emerges as a relevant phenomenon for understanding contemporary learning dynamics, particularly due to the mechanisms employed by digital platforms to capture and sustain users' attention. In light of this reality, the present study aims to analyze the implications of insightful attention engineering, situated within the context of digital culture, for the learning processes of Basic Education students, identifying its educational contributions and the challenges it poses to cognitive development and knowledge construction. The research was conducted following a qualitative approach and adopted a bibliographic review as its investigative procedure. The study was grounded in the analysis of scientific articles, book chapters, and specialized books addressing the themes of insightful attention engineering, digital culture, cognition, educational technologies, and learning. The findings revealed that insightful attention engineering influences learning processes in Basic Education, generating both opportunities and challenges for cognitive development. The investigation made it possible to understand the mechanisms underlying the attention economy, examine their impacts on learning, and analyze the contributions of digital technologies to meaningful educational experiences. It is concluded that the pedagogical use of technologies requires educational intentionality, qualified teacher mediation, and the critical development of students, thereby fostering attention, intellectual autonomy, and knowledge construction.

Keywords: insightful attention engineering; digital culture; learning; Basic Education.

RESUMO

A intensificação da cultura digital e a crescente presença das tecnologias no cotidiano de crianças e adolescentes têm promovido mudanças significativas nos modos de aprender e construir conhecimentos. Nesse contexto, a engenharia perspicaz da atenção constitui um fenômeno relevante para a compreensão das dinâmicas contemporâneas de aprendizagem, especialmente pelos mecanismos utilizados pelas plataformas digitais para captar e manter a atenção dos usuários. Diante dessa realidade, este estudo tem como objetivo geral analisar as implicações da engenharia perspicaz da atenção, inserida no contexto da cultura digital, para os processos de aprendizagem de estudantes da Educação Básica, identificando suas contribuições educacionais e os desafios que impõe ao desenvolvimento cognitivo e à construção do conhecimento. A pesquisa foi desenvolvida seguindo uma abordagem qualitativa e adotou a revisão bibliográfica como procedimento investigativo. O estudo fundamentou-se na análise de artigos científicos, capítulos de livros e livros especializados relacionados às temáticas da engenharia perspicaz da atenção, cultura digital, cognição, tecnologias educacionais e aprendizagem. Os resultados evidenciaram que a engenharia perspicaz da atenção influencia os processos de aprendizagem na Educação Básica, produzindo oportunidades e desafios para o desenvolvimento cognitivo. A investigação permitiu compreender os mecanismos da economia da atenção, seus impactos sobre a aprendizagem e as contribuições das tecnologias digitais para experiências educativas significativas. Conclui-se que o uso pedagógico das tecnologias requer intencionalidade educativa, mediação docente qualificada e

formação crítica dos estudantes, favorecendo a atenção, a autonomia intelectual e a construção do conhecimento.
Palavras-chave: engenharia perspicaz da atenção; cultura digital; aprendizagem; Educação Básica.

1. INTRODUCTION

Over the past decades, the increasing presence of digital technologies has fostered profound transformations in modes of communication, social interactions, access to information, and the production and circulation of knowledge. These changes have given rise to a new reality in contemporary society. It is within this context that digital culture has begun to exert a considerable influence on various aspects of modern life, enabling the development of new forms of interaction and social engagement. These transformations have also reshaped practices related to work, leisure, and education, introducing new dynamics and challenges into each of these domains. Consequently, the presence of digital culture is evident in numerous aspects of everyday life, transforming the ways individuals connect and participate in different activities.

Simultaneously, the development and dissemination of digital platforms operating through complex algorithms, content recommendation systems, and diverse engagement strategies have played a decisive role in establishing mechanisms designed to capture and retain users' attention. These platforms attract, sustain, and direct users' attention. As a result, such mechanisms have increasingly attracted the interest of the academic and scientific communities across different fields and disciplines.

Within the educational field, these transformations become even more significant, particularly when considering the profound and growing immersion of children and adolescents in the broad and complex world of contemporary digital technologies. The study of this phenomenon requires special attention from educators and educational institutions. It is undeniable that the constant and intensive interaction with social networks, messaging applications, content-sharing platforms, and other digital environments has generated multiple ways of learning. However, this reality also raises important questions regarding the effects that strategically manipulated attention may have on cognitive processes. Among these processes are attention itself, memory functioning, information processing, and, ultimately, knowledge construction. Therefore, it is essential to conduct a thorough examination of how the various tools that constitute digital culture may significantly affect educational processes in Basic Education. In this regard, it is necessary to reflect not only on the educational possibilities offered by these tools but also on the challenges they impose on student development in a society characterized by constant connectivity and technological interactivity. Understanding this relationship is therefore fundamental to fostering high-quality educational practices.

In light of this context, the present study aims to analyze the implications of insightful attention engineering, situated within the context of digital culture, for the learning processes of Basic Education students, identifying its educational contributions and the challenges it poses to cognitive development and knowledge construction. To achieve this purpose, three specific objectives were established: to understand the theoretical foundations of insightful attention engineering and its relationship with contemporary digital

culture; to investigate the impacts of insightful attention engineering on cognitive processes related to the learning of Basic Education students; and to analyze the challenges and contributions of digital culture in promoting pedagogical practices that foster meaningful learning in Basic Education.

From a methodological perspective, the investigation was conducted through a qualitative approach, which was essential for enabling not only interpretation but also a deeper understanding of the educational phenomena associated with the topic under examination. The study was developed through a systematic bibliographic review based on the careful analysis of relevant and significant scientific research related to the subject matter. This type of investigation enabled a more detailed exploration of the topic by drawing upon academic and scientific sources that enriched the understanding of the issues addressed.

To ensure a logical and well-structured presentation of the arguments, as well as greater clarity throughout the study, the article was organized into four main sections. These sections were designed to facilitate reading and provide greater coherence in the development of the discussion. The first section consists of the introduction, in which the objectives of the study and the methodological aspects guiding the investigation are presented. The second section comprises the theoretical framework, developed with the purpose of deepening the discussion of the principal conceptual references underpinning the research. The subsequent section presents the methodology, explaining how the study was conducted, including the procedures and stages followed throughout the research process. Finally, the concluding section provides an overview of the main findings obtained during the

study, as well as reflections that emerged from the analyses conducted throughout the investigation.

2. THEORETICAL FRAMEWORK

To provide greater logical organization to the development of this study, the theoretical framework was structured into three complementary and interconnected sections. The first section, 3.1 Insightful Attention Engineering and Digital Culture: Concepts, Characteristics, and Operating Mechanisms, was dedicated to discussing the conceptual foundations of insightful attention engineering, addressing aspects related to the attention economy, algorithms, persuasive design, digital platforms, and the culture of hyperconnectivity. The second section, 3.2 Attention, Cognition, and Learning in Basic Education, focused on the analysis of cognitive processes associated with learning, emphasizing sustained and selective attention, working memory, cognitive load, concentration, and contributions from neuroscience to the understanding of the mechanisms involved in knowledge construction. The third section, 3.3 Digital Culture, Educational Technologies, and Meaningful Learning, examined the relationships between digital technologies, digital competence, engagement, motivation, the pedagogical use of digital media, and students' critical development, highlighting the contributions of these elements to the promotion of meaningful learning in Basic Education.

2.1. Insightful Attention Engineering And Digital Culture: Concepts, Characteristics, And Operating Mechanisms

To understand insightful attention engineering, it is essential to recognize that human attention has become an increasingly

valuable and highly contested resource within the contemporary digital environment. In this context, the term attention economy refers to the set of strategies developed to attract, direct, and, more effectively, retain users within digital environments and platforms for extended periods. According to Williams (2018), digital platforms engage in intense competition for users' attention, establishing a dynamic in which individuals' cognitive processes are treated as valuable economic assets with substantial market value. This competitive dynamic significantly transforms relationships with information, patterns of consumption, forms of communication, and learning processes. Such transformations are particularly evident among children and adolescents immersed in environments characterized by constant connectivity. Thus, according to the aforementioned author, interaction with technology and social media progressively shapes young people's experiences and influences the ways they relate to the world around them.

The dissemination and growing acceptance of digital platforms over recent years have considerably expanded the capacity to monitor, evaluate, and even anticipate the actions and behaviors of those who interact with these technological environments. This evolution not only enables companies and institutions to better understand user behavior but also enhances their ability to engage with users in more effective and targeted ways. A major challenge lies in ensuring that these interactions remain beneficial and do not become mechanisms for capturing students' attention without providing meaningful learning experiences. As Bucher (2018) observes, algorithms have evolved from simple technical functionalities to assume a central role in organizing and shaping social life within the contemporary digital environment. Through the continuous collection of data, algorithmic systems categorize content,

personalize experiences, and determine which information receives greater visibility and relevance. Consequently, individuals establish relationships with digital environments governed by algorithms that play a fundamental role in shaping browsing habits, information preferences, and modes of interaction within digital platforms.

The operation of algorithmic personalization is intrinsically linked to the economic system that underpins digital platforms. This intersection between personalization logic and economic models reveals a direct and significant relationship, whereby personalization strategies are shaped by the financial and operational dynamics governing these platforms. According to Couldry and Mejias (2019), the systematic and continuous collection of personal data constitutes an essential and inherent component of what they define as data capitalism. Within this context, individuals' everyday experiences, often perceived as ordinary and insignificant, are transformed into valuable resources for detailed analysis, market segmentation, and monetization practices. These processes demonstrate how personal information can be converted into capital within this emerging economic model.

Within this framework, users' attention is not merely monitored but is continuously shaped through systems that rely on behavioral data to optimize interactions and maximize content dissemination. These systems analyze collected behavioral information to personalize user experiences, making content more appealing to each individual engaging with the platforms. As a result, interactions become increasingly intensive, reinforcing the effectiveness of engagement-maximization strategies.

Another particularly relevant aspect concerns the persuasive design employed by many digital platforms. These platforms utilize visual and interface strategies intended to influence user behavior. According to Hendricks and Vestergaard (2018), numerous digital interfaces are designed to encourage repetitive behaviors through mechanisms such as constant notifications, intermittent rewards, automatically generated suggestions, and real-time feedback. These elements encourage users to repeatedly engage in actions associated with the stimuli they receive.

These mechanisms are capable of exploiting a wide range of mental processes closely associated with curiosity, anticipation, and the desire for social recognition. Consequently, they foster ongoing interactions that generate self-reinforcing cycles, sustaining continuous engagement. Persuasive design, combined with algorithmic personalization, plays a fundamental role in enhancing the capacity of digital platforms to keep users engaged and attentive for prolonged periods. This occurs because the strategies developed by these platforms capture users' attention by responding to their preferences and behavioral patterns, thereby promoting sustained engagement with targeted content (Hendricks & Vestergaard, 2018).

Bucher and Helmond (2018) emphasize that affordances, understood as the action possibilities offered by social platforms, extend beyond merely enabling specific forms of interaction among users. Rather, they play a crucial role in shaping behaviors and experiences within digital environments, influencing how individuals engage with content and interact with one another. In this way, users continue to be "captured" by platform dynamics. Functionalities such as liking, sharing, and commenting, as well as

indicators of popularity and automated recommendations, exert a substantial influence on how individuals consume and disseminate content across social networks and other digital environments. In the absence of adequate regulatory oversight, these mechanisms may also contribute to the spread of misinformation and fake news. To synthesize the principal elements that constitute insightful attention engineering and its relationship with contemporary digital culture, Table 1 is presented below.

Table 1. Constitutive Elements of Insightful Attention Engineering in Contemporary Digital Culture

Dimension	Main Characteristics	Operating Mechanisms	Implications for Digital Environments
Attention Economy	Competition for users' attention	Behavioral monitoring, engagement metrics, and retention strategies	Increased time spent on platforms
Algorithms	Content personalization and filtering	Data processing and automated recommendations	Selection and prioritization of information
Persuasive Design	Encouragement of continuous interaction	Notifications, variable rewards, and instant feedback	Intensification of digital engagement
Social Media	Mediation of social interactions	Likes, shares, comments, and popularity metrics	Influence on behaviors and communication practices

Culture of Hyperconnectivity	Permanent connectivity	Continuous flows of information and communication	Constant exposure to digital stimuli
Data Capitalism	Transformation of data into economic value	Collection, analysis, and monetization of behavioral data	Consolidation of economic models based on surveillance and personalization
Attention Ecology	Quality and sustainability of attention	Balance between digital interaction and reflective processes	Promotion of more balanced cognitive experiences

Source: Bentes (2026); Bompaerts et al. (2026); Bucher (2018); Bucher and Helmond (2018); Couldry and Mejias (2019); Hendricks and Vestergaard (2018); Jones, Jaworska, and Aslan (2020); Williams (2018).

What can already be observed is that the deep interconnection among algorithms, interfaces, and the various devices designed to promote user engagement has contributed to strengthening a culture characterized by hyperconnectivity (Jones, Jaworska, & Aslan, 2020).

Jones, Jaworska, and Aslan (2020) emphasize that contemporary digital media have been designed to provide continuous and uninterrupted flows of information, resulting in a substantial reduction in the intervals that once existed between different forms of communication, media consumption practices, and digitally mediated social interactions. At the same time, face-to-face social interaction has become increasingly limited. As a consequence, there has been a concerning increase in individuals' exposure to

multiple and simultaneous stimuli, as well as to an ever-growing volume of informational demands that continuously compete for attention.

This scenario has generated significant transformations in the ways attention is directed, time is managed, and knowledge is constructed. Consequently, these changes affect not only individuals' capacity to concentrate but also influence temporal management and the processes through which knowledge is acquired, developed, and shared.

Contemporary discussions surrounding the attention economy have also been shaped by critical perspectives concerning the viability and sustainability of attention-related processes. Such critiques are particularly focused on the growing recognition that these mechanisms may contribute to attention deficits among learners, ultimately leading to declines in learning outcomes (Bombaerts et al., 2026).

According to Bombaerts et al. (2026), most existing models are grounded in the objective of maximizing user engagement. This emphasis has raised substantial concerns regarding the quality of human attention and has prompted reflections on the conditions necessary to foster more critical and reflective forms of engagement. Such reflections are especially important in light of the prolonged periods users spend interacting with digital platforms, often at the expense of activities that could contribute to meaningful learning and civic development.

The authors advocate an attention ecology perspective, emphasizing the importance of understanding how interactions

among digital technologies, social behaviors, and cognitive conditions play a fundamental role in promoting more balanced and productive forms of engagement, capable of contributing to the development of participatory and critically minded citizens.

Expanding upon this discussion, Bentes (2026) argues that the digital attention economy should not be viewed merely as a recent phenomenon but rather as a historical process closely linked to the rise and expansion of digital platforms and data-driven business models. This process is also associated with the algorithmic mediations that increasingly shape contemporary social life.

Within this context, insightful attention engineering emerges as a complex strategic combination of technological, economic, and communicational actions, broadly consistent with the perspectives advanced in the studies discussed thus far. These actions are deliberately designed to influence and shape behavior within digital environments. Understanding the foundations that govern this digital reality is of paramount importance for the field of education, particularly because students in Basic Education construct a significant portion of their social, cultural, and cognitive experiences within these digital ecosystems. It is important to emphasize that such environments are characterized not only by the personalization of experiences but also by the constant connectivity, or hyperconnectivity, that links users to one another. This dynamic directly affects students' learning processes and developmental trajectories (Bentes, 2026).

2.2. Attention, Cognition, And Learning In Basic Education

Attention is undoubtedly one of the most important and indispensable cognitive processes for school learning, as it functions as the decisive filter that determines which information will be processed by the cognitive system and which information will be disregarded. In this sense, attention is essential for enabling students to focus on relevant information and transform it into meaningful learning. Within the context of Basic Education, the ability to direct attention toward learning-relevant stimuli has a direct impact on how students understand, retain, and apply acquired knowledge. According to Costa, Nóbile, and Crespi (2021, p. 12):

> *Learning occurs through the integration of the organism with its environment, mediated by neural pathways. From this understanding of brain function, it can be affirmed that the brain provides the biological architecture necessary for the development of cognitive abilities. Learning is an extremely complex function, and among the cognitive processes resulting from primary cognitive mechanisms are sensation, perception, attention, and memory.*

This competency is fundamental because it relates to how students identify and prioritize information that is genuinely relevant to their learning, thereby influencing academic performance and the development of essential skills and competencies throughout their educational trajectories. Recent studies in the field of neuroeducation have demonstrated that students achieve more

effective learning outcomes when teaching approaches and instructional methods are capable of maintaining their focus on academic activities while simultaneously reducing distractions that may hinder the assimilation and processing of information (Santos et al., 2026; Costa et al., 2021).

Santos et al. (2023) emphasize that among the various forms of attention, two are particularly relevant: selective attention, which involves focusing on a specific stimulus while ignoring competing stimuli, and sustained attention, defined as the capacity to remain focused on a task over an extended period. Selective attention is essential because it enables students to distinguish relevant information from a multitude of competing stimuli. Sustained attention, in turn, allows learners to maintain concentration and engagement in a particular activity for prolonged periods, a condition that is often decisive for effective learning.

In today's environment, characterized by the rapid circulation of digital information, these attentional capacities have become increasingly important for academic success. Santos et al. (2023) argue that the ability to manage distractions and sustain focus on cognitively demanding activities contributes significantly to long-term learning outcomes.

Expanding this discussion, it is important to highlight that working memory, which is directly associated with meaningful learning, represents a fundamental component of the cognitive process. Working memory temporarily stores and processes information necessary for the execution of a wide range of cognitive functions. This mechanism is crucial because it enables information to be accessed and manipulated according to immediate demands,

thereby facilitating learning and problem-solving processes (Costa; Nóbile; Crespi, 2021).

Costa, Nóbile, and Crespi (2021) further argue that meaningful learning occurs through the interaction among attention, working memory, and long-term memory. For learning to be consolidated, information initially selected by the learner must be processed, organized, and subsequently integrated with preexisting knowledge structures. The interaction among these elements is essential for promoting the effective and lasting internalization of new knowledge. Consequently, when this process occurs successfully, learners are more likely to achieve a deep understanding of concepts and to apply knowledge effectively in problem-solving situations.

According to Kato et al. (2024), working memory is closely associated with cognitive load, understood as the amount of mental resources required to perform a particular activity effectively, whether in everyday situations or in learning contexts. Cognitive load plays a crucial role in understanding how the brain processes information during task execution, as the efficient allocation of mental resources directly influences performance and task effectiveness. Therefore, the relationship between working memory and cognitive load is fundamental for understanding both the limitations and the potential of the human mind when confronted with complex tasks.

From the perspective of neuroeducation, excessive exposure to information, often intensified by hyperconnectivity, as well as the presence of competing stimuli and excessively demanding tasks, can overload students' cognitive systems. Such overload may

significantly impair learning processes, making effective knowledge acquisition increasingly difficult (Kato et al., 2024).

Kato et al. (2024) also emphasize that pedagogical practices should not be designed without considering students' cognitive limitations. Consequently, educational content and learning experiences must be carefully structured to ensure the gradual development of understanding, thereby enabling the consistent and robust construction of knowledge over time.

Silva et al. (2025) and Kato et al. (2024) demonstrate that neuroscience has become an important ally in expanding knowledge about teaching and learning processes by providing a deeper understanding of the neural mechanisms underlying these complex phenomena. The relationship between neuroscience and education has generated significant insights into how the brain functions during learning, revealing essential factors that influence the effectiveness of pedagogical approaches implemented in educational settings. According to Silva et al. (2025), a deeper understanding of brain functioning can contribute substantially to the development and refinement of pedagogical practices that are more closely aligned with students' cognitive characteristics.

This perspective suggests that, by understanding the mechanisms through which the brain learns, educators can design instructional approaches that take into account students' specific needs and cognitive characteristics, including their capacities for information processing and knowledge acquisition. Within this framework, attention, memory, emotion, and motivation are understood as interdependent factors that collectively influence students' academic performance and knowledge construction throughout

different stages of learning. This interdependence highlights the complexity of learning and underscores the importance of addressing these dimensions in an integrated manner to optimize educational outcomes (Silva et al., 2025).

Contemporary literature also emphasizes the importance of teacher education, highlighting that adequate preparation is essential for ensuring that knowledge derived from neuroscience is effectively incorporated into pedagogical practice (Grossi, Oliveira, & Fonseca, 2024; Silva et al., 2025).

The perspective advanced by Grossi, Oliveira, and Fonseca (2024) suggests that the intersection among educational curricula, advances in neuroscience, and teacher education creates opportunities for the development of instructional strategies that are more responsive to the cognitive mechanisms involved in learning. This perspective underscores the importance of understanding students' mental processes in order to maximize educational effectiveness. Such understanding enables the creation of learning environments that encourage active student participation, diversify teaching approaches, and provide cognitively meaningful and enriching experiences. The ultimate goal is to establish educational contexts that engage students effectively and motivate them to participate actively in pedagogical activities. To synthesize the principal relationships among attention, cognition, and learning in Basic Education, Table 2 is presented below.

Table 2. Relationships Between Cognitive Processes and Learning in Basic Education

Cognitive Process	Main Characteristics	Function in Learning	Pedagogical Implications
Selective Attention	Selection of relevant stimuli	Directing focus toward important information	Reduction of distractions and organization of educational stimuli
Sustained Attention	Maintenance of focus over time	Continuity of cognitive processing	Planning of activities that promote prolonged concentration
Working Memory	Temporary storage and manipulation of information	Comprehension and resolution of complex tasks	Gradual organization of content and learning activities
Cognitive Load	Amount of mental effort required	Influence on information processing	Balance between task complexity and students' cognitive capacity
Long-Term Memory	Consolidation of acquired knowledge	Retention and retrieval of information	Use of review strategies and connections among learning content
Motivation and Engagement	Emotional and cognitive mobilization for learning	Sustaining interest and participation	Implementation of active and contextualized methodologies
Neuroplasticity	Capacity for cerebral adaptation and reorganization	Continuous development of learning processes	Diversification of educational experiences and cognitive stimulation

Source: Costa, Nóbile, and Crespi (2021); Gasque (2018); Gomes et al. (2024); Grossi, Oliveira, and Fonseca (2024); Hallal, Pinheiro, and Oliveira (2021); Kato et al. (2024); Santos et al. (2023); Santos et al. (2026); Silva et al. (2025).

At this point, active learning methodologies deserve particular attention because they have proven effective in stimulating students' cognitive engagement in learning activities. These approaches also contribute to sustaining attention more consistently and for longer periods. According to Hallal, Pinheiro, and Oliveira (2021), pedagogical strategies mediated by active learning methodologies promote greater student participation, which tends to significantly enhance learners' interest and engagement in educational activities.

Thus, active learning methodologies not only foster deeper student engagement but also strengthen critical reflection, the ability to analyze learning situations more thoroughly, and the skills required to identify and solve problems effectively. Within the context of Basic Education, this approach can be observed, for example, through Project-Based Learning (PBL), in which students investigate real-world problems affecting their communities. Throughout this learning process, they are encouraged to formulate hypotheses, develop potential solutions, and share the results of their investigations. Such dynamics not only connect students more closely to the realities in which they live but also promote the development of critical thinking and problem-solving competencies. Importantly, these benefits can be achieved without students necessarily being connected to digital platforms (Cabral et al., 2020; Hallal; Pinheiro; Oliveira, 2021; Gomes et al., 2024).

For instance, when students are engaged in the development of an interdisciplinary project addressing the problem of improper solid waste disposal in areas surrounding the school, they must conduct detailed research to gather relevant information on the issue. The work should be collaborative, requiring participants to interact and cooperate with one another. Furthermore, students must engage in the critical analysis of the collected data and, based on their findings, propose interventions that may contribute to solving the identified problem. In this way, learners remain actively involved in activities that require not only sustained attention but also dynamic and participatory engagement, both of which are essential for the successful completion of the project (Gomes et al., 2024; Hallal; Pinheiro; Oliveira, 2021).

In this regard, active learning methodologies emerge as valuable pedagogical strategies capable of enhancing students' focus, fostering learner agency, and promoting meaningful knowledge construction. These approaches stand in contrast to the logic of attentional fragmentation frequently associated with contemporary digital environments. Consequently, they support educational practices that place greater value on students' active participation in the learning process, thereby fostering educational experiences that are more integrated and less fragmented (Gomes et al., 2024; Hallal; Pinheiro; Oliveira, 2021). Hallal, Pinheiro, and Oliveira (2021, p. 03) state that:

> *In this conception of teaching and learning, the teacher acts as a mediator, enabling students to conduct research, reflect, and collaboratively decide with their peers how to achieve the established objectives, while simultaneously proposing new discussions and challenges. Consequently, this perspective requires a new professional posture from educators, one that is capable of adapting pedagogical practices to the emerging demands of contemporary society. Therefore, the search for diverse teaching methodologies aimed at fostering student autonomy and engagement throughout the learning process becomes essential. These approaches are commonly referred to as active learning methodologies (Hallal, Pinheiro, & Oliveira, 2021, p. 03).*

Similarly, Gomes et al. (2024) argue that methodological strategies that promote student autonomy encourage active participation and strengthen learners' agency within educational experiences. As a result, students become capable of mobilizing a variety of cognitive resources associated with attention, memory, and the development of critical thinking.

Within the context of Basic Education, it is essential to understand both why and for what purpose teaching takes place. This perspective implies the implementation of educational practices that extend beyond the mere transmission of content, fostering learning situations that involve research, collaboration, decision-

making, and problem-solving. By creating opportunities for students to assume a leading role in the construction of knowledge, teachers also strengthen sustained attention and cognitive engagement, both of which are crucial in a society where digital technologies compete intensely for individuals' attention. Consequently, methodologies that prioritize student participation become fundamental for enhancing learning outcomes and cultivating the competencies required for students to become critical and autonomous individuals (Cabral et al., 2020; Hallal, Pinheiro, & Oliveira, 2021; Gomes et al., 2024).

Gasque (2018) emphasizes that, beyond the specific aspects of human brain functioning, contemporary learning also requires competencies that extend beyond information literacy, including the conscious and intentional use of available cognitive resources. In other words, meeting the demands of contemporary education requires not only an understanding of neural functioning but also the ability to locate, evaluate, and effectively use information in ways that promote meaningful and reflective learning.

According to Gasque (2018), competence in understanding the cognitive processes involved in searching for, selecting, and using information is indispensable. This perspective may serve as an important foundation for reorienting educational practices, making them more consistent and effective in addressing the challenges of the digital age. In this regard, Basic Education teachers should design learning experiences that encourage students' autonomy in the search, analysis, and critical use of information. Through such experiences, learners develop essential skills for dealing consciously and reflectively with the information overload that characterizes contemporary digital environments.

It can therefore be concluded that the interrelationship among neuroscience, attention, memory, cognitive load, and teaching methodologies is fundamental for understanding how Basic Education students learn within increasingly complex environments characterized by abundant information and pervasive technologies. Understanding these interconnections is essential for addressing the challenges posed by insightful attention engineering and for implementing pedagogical practices capable of fostering meaningful learning within contemporary digital culture (Grossi, Oliveira, & Fonseca, 2024; Kato et al., 2024).

2.3. Digital Culture, Educational Technologies, And Meaningful Learning

Digital culture has profoundly transformed the ways in which knowledge is accessed, produced, shared, and disseminated, directly impacting contemporary educational processes. Throughout the development of modern society, digital technologies have evolved from complementary resources into central elements of current learning experiences. However, the incorporation of these technologies into educational settings requires educators to recognize that students interact daily with multiple languages, platforms, and digital environments. This reality makes it necessary for pedagogical practices to adapt to new ways of learning, interacting, and constructing knowledge (Santos et al., 2026; Ferreira, 2020).

When discussing meaningful learning, that is, learning that connects relevant new knowledge to students' prior knowledge, the integration of digital technologies into the school curriculum

becomes particularly justified. In this regard, Santos et al. (2025, p. 03) explain that:

> *Basically, cognitive learning is related to the acquisition of knowledge, concepts, ideas, and principles. Meaningful learning is a process through which new information becomes connected to a particularly significant element within an individual's network of knowledge. The human brain has a unique way of storing information: some data are retained, others are lost, and those that remain become embedded within an individual's cognitive structure.*

Meaningful learning should therefore be understood as the incorporation of new knowledge into existing cognitive structures, implying that new information must be meaningfully connected to prior knowledge. This perspective encourages reflection on the importance and role that digital technologies have assumed within teaching and learning processes (Zilio, Crespi, & Nobile, 2020).

It is also necessary to consider how these resources may either facilitate or hinder such integration, thereby influencing the ways students assimilate and apply acquired knowledge. Consequently, investigating how digital tools contribute to meaningful learning processes becomes essential. However, many digital environments are designed according to principles associated with insightful attention engineering, employing strategies and systems whose primary objective is to capture and sustain users' attention rather

than to promote meaningful learning as an ultimate educational goal (Zilio, Crespi, & Nobile, 2020; Silva et al., 2025; Santos et al., 2025).

Within this context, technologies possess the potential to enrich knowledge construction by fostering more interactive and dynamic learning experiences. On the other hand, these same technologies may also become barriers to deeper reflection, depending on the pedagogical mediation employed and the educational intentions guiding their use. Thus, whether technological tools function as facilitators or obstacles to learning depends largely on how they are integrated into educational practice (Zilio, Crespi, & Nobile, 2020; Silva et al., 2025; Santos et al., 2025).

It is also important to highlight the growing relevance of multiliteracies within contemporary education, as they expand opportunities for reading, interpreting, and producing meaning through diverse languages and digital media. According to Silva et al. (2025), the integration of digital technologies with multiliteracies promotes more contextualized, meaningful, and participatory learning experiences. Through participation in interdisciplinary projects, problem-solving activities, and other strategies mediated by videos, infographics, collaborative platforms, simulations, and digital learning environments, students develop the ability to critically interpret information, communicate through multiple modes, and collaboratively construct knowledge.

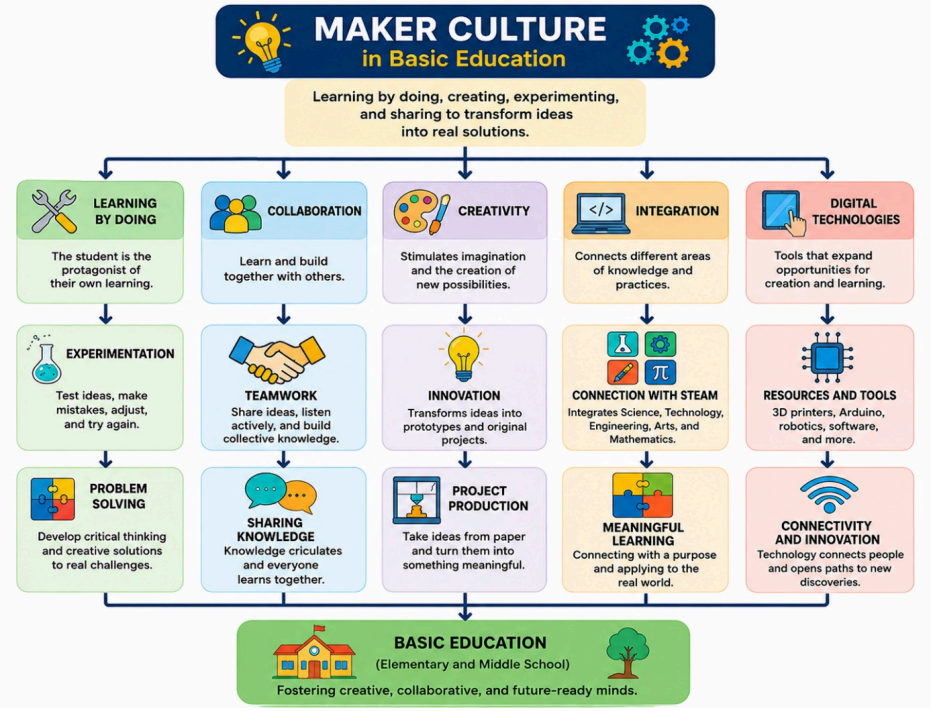
Another important aspect concerns digital competence, understood as the set of knowledge, skills, and attitudes required for the ethical, critical, creative, and responsible use of technology. Ferreira (2020) argues that education for digital culture extends beyond the mere ability to operate technological tools, encompassing an

understanding of their social, cultural, and educational implications. In this regard, schools play a strategic role in preparing learners who are capable of critically evaluating digital content, verifying the reliability of information, and participating consciously in online environments characteristic of contemporary society without compromising their capacity for learning.

The relationship between digital culture and student engagement has also become a prominent topic within recent educational literature (Costa et al., 2026; Bondan & Cerutti, 2026). According to Santos et al. (2023), learning processes are enhanced when students actively engage in educational activities and establish meaningful connections between school learning and their everyday experiences. Findings from neuroscience support this perspective, demonstrating that attention, motivation, emotion, and memory operate in an integrated manner during knowledge construction.

In this context, it is particularly relevant to emphasize the contributions of the Maker Culture and STEAM methodologies to the promotion of active learning. Figure 1 presents key elements that characterize this educational movement, including learning by doing, experimentation, creativity, collaboration, innovation, interdisciplinary integration, and the use of digital technologies. As illustrated in the figure, these components interact to create educational experiences that prioritize authorship, problem-solving, project development, and active student participation. Learning environments inspired by Maker Culture contribute significantly to knowledge construction through practice, collaboration, and the application of academic content to authentic contexts (Costa et al., 2026; Bondan & Cerutti, 2026).

Figure 1 – Conceptual Map of Maker Culture in Basic Education



Source: Costa et al. (2026, p. 07)

Learning is greatly enhanced when digital technologies are combined with innovative methodologies that place students at the center of the process. In this regard, Gomes et al. (2026) demonstrate that both educational robotics and interdisciplinary approaches can serve as important strategies for stimulating students' interest, strengthening cognitive skills, and contributing to learning recovery. According to the authors, these elements can foster competencies related to logical reasoning, creativity, and problem solving. When students are encouraged to experience these elements, their capacities to become protagonists in the construction of knowledge are expanded, using technologies even as tools for research and intellectual production (essential for participation in educational Olympiads and science fairs).

However, for digital technologies to be effectively integrated into education, a critical understanding of their limitations and potentialities is essential. As Santos et al. (2026, p. 06) maintain,

> *The digital culture compels Basic and Higher Education to rethink pedagogical practices, curricula, methodologies, and modes of interaction. The integration of digital technologies cannot be seen merely as a technical update, but as a transformation in the ways of teaching, learning, investigating, producing knowledge, and acting socially. Throughout the text, it was possible to perceive that technology indeed brings benefits to learning when it is articulated with clear pedagogical objectives, qualified teacher mediation, and a commitment to the critical formation of students.*

Thus, meaningful learning in the digital culture is realized through the establishment of pedagogical practices that integrate technological innovation, educational intentionality, and critical formation, enabling students to participate more consciously and actively in the various social and digital contexts they inhabit.

Finally, it is important to emphasize that, in a blog article on Inteligência de Vida (2023), pediatrician Daniel Becker discussed the dangers of excessive screen use. According to the specialist, there is no escaping the digital world; however, real-world experience must also be preserved. Becker points out that if a child or adolescent spends many hours connected to digital platforms, they risk becoming distanced from experiences that are fundamental to their cognitive, emotional, and social development. In conclusion, the physician advocates for setting limits on screen time so that children and adolescents can recover and develop more effectively.

3. METHODOLOGY

This research was developed from the understanding that the increasing incorporation of digital technologies into diverse social spaces has produced significant changes in modes of communication, interaction, and knowledge construction. In the educational sphere, such changes assume particular relevance in light of the consolidation of digital culture and the expansion of mechanisms associated with the keen engineering of attention, which are capable of influencing behaviors, patterns of informational consumption, and cognitive processes related to learning. Given the direct relation of this theme to contemporary Basic Education, it was considered pertinent to investigate how these phenomena/mechanisms are reflected in students' learning processes, thereby contributing to the expansion of scientific discussions regarding the challenges and educational possibilities that emerge in this context.

Regarding the methodological approach, the investigation is characterized as qualitative. According to Guilherme and Cheron (2021), qualitative research enables the comprehension of complex phenomena through the interpretation of meanings, contexts, relations, and human experiences, favoring analyses that go beyond the mere measurement of variables. Its wide use in international scientific production stems from the capacity to examine social, educational, and cultural phenomena in their multidimensionality, allowing for consistent interpretations of processes that involve values, perceptions, behaviors, and social practices. In the field of Education, this approach has contributed significantly to the understanding of phenomena related to learning, human formation, and the transformations arising from technological and sociocultural

changes that characterize contemporary times. In this vein, Sousa and Santos (2020) emphasize that qualitative research favors the construction of contextualized interpretations of investigated phenomena, enabling the comprehension of meanings and relations that could scarcely be captured exclusively by quantitative procedures.

With respect to methodological procedures, a literature review was employed. This research procedure occupies a prominent position in global scientific inquiry because it enables systematic access to the knowledge already produced about a given object of study, facilitating the identification of theoretical trends, conceptual advances, investigative gaps, and diverse analytical perspectives. As Guilherme and Cheron (2021) highlight, the literature review constitutes a relevant instrument for the consolidation of scientific knowledge, since it makes possible the gathering, organization, analysis, and interpretation of contributions previously produced by the academic community. Complementarily, Sousa and Santos (2020) observe that the systematic analysis of scientific productions represents an indispensable stage for the construction of well-founded interpretations, contributing to the theoretical and methodological rigor of investigations.

The literature review conducted in this study was based on the analysis of twenty-six scholarly works directly related to the thematic axes previously specified. The analyzed corpus comprised peer-reviewed journal articles, chapters from scholarly books, and academic monographs. The selection of works followed criteria of thematic relevance, contemporaneity, academic significance, and alignment with the research objectives, enabling the construction of

a theoretical framework that is both consistent and representative of contemporary discussions on the investigated topic.

The combination of a qualitative approach and a literature review proved appropriate to the objectives of this investigation. Whereas the qualitative approach allowed for critical interpretation of the phenomena analyzed and for understanding their multiple educational, cognitive, and sociocultural dimensions, the literature review provided theoretical support for the systematization and analysis of knowledge produced about the object of study. Thus, the employed methodological strategy contributed to ensuring theoretical consistency, analytical coherence, and scientific rigor in the development of the research, permitting the attainment of the proposed objectives and the production of well-grounded reflections on the studied topics.

4. FINAL CONSIDERATIONS

The increasing incorporation of digital technologies into everyday life has produced profound changes in modes of communication, access to information, social relations, and knowledge production. The keen engineering of attention therefore refers to the technological, algorithmic, and communicative maneuvers orchestrated to capture, steer, and retain people's attention in the digital space. It is imperative to investigate how these mechanisms affect cognitive and educational processes, particularly because children and adolescents in Basic Education are increasingly integrated into digital culture.

The research findings indicate that the general objective was fully achieved, insofar as the study examined the implications of the keen

engineering of attention, within digital culture, for the learning processes of Basic Education students—both with respect to educational opportunities and regarding the challenges posed to cognitive development and knowledge construction. The specific objectives were also met. In the first section of the theoretical framework it was emphasized that the attention economy is one of the principal drivers of contemporary digital platforms. It was identified that algorithms, recommendation systems, persuasive design, and personalization operate together to shape behaviors, increase engagement, and guide information consumption. Furthermore, it was understood that the culture of hyperconnectivity exposes individuals to a constant stream of diverse digital stimuli, producing considerable effects on interactions, communication, and information processing.

In the following section it was found that cognitive processes are essential for learning in school contexts. The reviewed literature showed that sustained attention, selective attention, working memory, and effective management of cognitive load directly impact both the quality of learning and the consolidation of knowledge. As findings from the neurosciences point to the substantial influence of motivation, emotion, attention, and the organization of learning experiences on academic performance, it is crucial that pedagogical practice be grounded in scientific evidence concerning cognitive functioning. With regard to Digital Culture, Educational Technologies, and Meaningful Learning, topics addressed specifically in the third section of the theoretical framework, the research demonstrated that digital technologies can provide more participatory, collaborative, and contextualized learning experiences, provided they are employed with clear pedagogical objectives. However, it became evident that merely

introducing technologies into education does not guarantee advances in learning; high-quality teacher mediation, sound pedagogical planning, and the critical formation of students are essential.

Overall, the results indicate an ambivalence of the keen engineering of attention in the school context. Although digital platforms have the potential to expand opportunities for access to information, interaction, and learning, their inappropriate use can lead to distraction, fragmentation of attention, and cognitive overload if appropriate pedagogical criteria are not established.

For future research, it is suggested that empirical studies with Basic Education students be conducted to observe the actual effects of the keen engineering of attention on academic performance, attentional processes, and meaningful learning. It is also worthwhile to investigate how algorithms and social networks interface with the study habits of children and adolescents. Further studies could explore teaching strategies aimed at strengthening attentional self-regulation, critical digital competence, and the responsible use of educational technologies, thereby contributing to the development of educational practices better suited to the challenges of contemporary society.

REFERENCES

BENTES, A. Digital attention economy: concept, phenomenon, and history in platform studies. **AoIR Selected Papers of Internet Research,** [S. l.], 2026. https://doi.org/10.5210/spir.v2024i0.15066.

BOMBAERTS, G.; HANNES, T.; ADAM, M.; et al. Beyond the attention economy, towards an ecology of attending: a manifesto. **AI &**

Society, v. 41, p. 477-492, 2026. https://doi.org/10.1007/s00146-025-02405-8.

BONDAN, A. dos S.; CERUTTI, E. Creative education and digital technologies: maker culture in education. **Revista Foco,** [S. l.], v. 19, n. 6, e11983, 2026. https://doi.org/10.54751/revistafoco.v19n6-006.

BUCHER, T. **If... then:** algorithmic power and politics. Oxford: Oxford University Press, 2018.

BUCHER, T.; HELMOND, A. The affordances of social media platforms. In: BURGESS, J.; MARWICK, A.; POELL, T. (ed.). **The SAGE handbook of social media.** London: SAGE Publications, 2018. p. 233-253. https://doi.org/10.4135/9781473984066.n14.

CABRAL, C. P.; VIANA, K. O. F. L.; RABELO, P. S. T.; NASCIMENTO, P. P. C.; POURBAIX, A. R. S.; CUNHA, T. C. O. Communication and multiple languages: pedagogical experiences in an integrative project. **Perspectivas Online: Humanas & Sociais Aplicadas,** v. 10, n. 28, p. 60-79, 2020. ISSN: 2236-8876. http://dx.doi.org/10.25242/8876102820202017.

COSTA, C.; NÓBILE, M.; CRESPI, L. R. S. Understanding the learning process: contributions of neuroeducation. **Revista Pedagógica,** [S. l.], v. 23, p. 1-28, 2021. https://doi.org/10.22196/rp.v22i0.6019.

COSTA, J. A. et al. Maker culture and STEAM in basic education: innovative approaches to active learning. In: CARVALHO, I. de S. (org.); VALENTE, N. A. (ed.). **Pedagogical transformations and educational innovation.** 2. ed. São José dos Pinhais: Seven Editora, 2026. p. 53-67. ISBN: 978-65-6109-316-3. https://doi.org/10.56238/sevened2026.018-006.

COULDRY, N.; MEJIAS, U. A. **The costs of connection:** how data is colonizing human life and appropriating it for capitalism. Stanford, CA: Stanford University Press, 2019.

FERREIRA, J. de L. Digital culture and teacher education: an analysis from the perspective of students in the Pedagogy Degree Program. **Educar em Revista,** Curitiba, v. 36, e75857, 2020. https://doi.org/10.1590/0104-4060.75857.

GASQUE, K. C. G. D. Behavior, information literacy and brain research: applications in learning. **Pesquisa Brasileira em Ciência da Informação e Biblioteconomia,** [S. l.], v. 13, n. 2, 2018. Available at: https://pbcib.com/pbcib/article/view/43260. Accessed on: May 26, 2026.

GOMES, R. L. R. et al. Educational robotics and interdisciplinarity as tools for learning recovery in contexts of cell phone use and misuse in the classroom. **IOSR Journal of Research & Method in Education (IOSR-JRME),** v. 16, n. 3, ser. 2, p. 23-34, 2026. p-ISSN: 2319-7668. https://doi.org/10.9790/7388-1603022434.

GOMES, R. L. R. et al. The relationship between active methodologies as teaching strategies and educators' autonomy. **IOSR Journal of Business and Management (IOSR-JBM***)*, v. 26, n. 8, ser. 9, p. 74-84, 2024. e-ISSN: 2278-487X. https://doi.org/10.9790/487X-2608097484.

GROSSI, M. G. R.; OLIVEIRA, E. S.; FONSECA, R. G. P. Curriculum, neuroscience and teacher education. **Revista e-Curriculum,** [S. l.], v. 22, e59967, 2024. https://doi.org/10.23925/1809-3876.2024v22e59967.

GUILHERME, A. A.; CHERON, C. **Practical guide to educational research.** Caxias do Sul: Educs, 2021.

HALLAL, R.; PINHEIRO, N. A. M.; OLIVEIRA, R. de. Integration among active methodologies: pedagogical practices for teaching and learning processes. **EDUCA - Revista Multidisciplinar em Educação,** [S. l.], v. 8, p. 1-25, 2021. https://doi.org/10.26568/2359-2087.2021.5628

HENDRICKS, V. F.; VESTERGAARD, M. **Reality lost:** markets of attention, misinformation and manipulation. Cham: Springer, 2018. https://doi.org/10.1007/978-3-030-00813-0.

INTELIGÊNCIA DE VIDA. **LIV podcast:** pediatrician Daniel Becker debates the risks of excessive screen use. Rio de Janeiro: Inteligência de Vida, 2023. Available at: https://www.inteligenciadevida.com.br/pt/conteudo/pediatra-daniel-becker-debate-riscos-do-uso-excessivo-de-telas/. Accessed 29 June 2026.

JONES, R. H.; JAWORSKA, S.; ASLAN, E. Media and the attention economy. In: JONES, R. H.; JAWORSKA, S.; ASLAN, E. **Language and media.** London: Routledge, 2020. https://doi.org/10.4324/9781003084211-8.

KATO, A. A. G.; LIMA, L. K. A.; SILVA, D. D.; SILVA, D. S.; SANTOS, C. H. A.; MALTA, D. P. L. N. Neuroscience and education: practical approaches to improve the teaching and learning process. **Aracê,** [S. l.], v. 6, n. 2, p. 1602-1617, 2024. https://doi.org/10.56238/arev6n2-070.

SANTOS, A. et al. Digital culture and pedagogical practices: reflections on the integration of technologies in basic and higher education. **Revista Tópicos,** Rio de Janeiro, v. 4, n. 34, p. 1-23, 2026. ISSN: 2965-6672. https://doi.org/10.70773/revistatopicos/781195287.

SANTOS, L. A. da S.; TAVARES, A. M. B. do N.; SOUZA, I. A. R. de; MARTINS NETO, A. V.; ALVES, C. M. Neuroscience and learning: brief notes derived from neuroscientific evidence. **Revista Foco,** [S. l.], v. 16, n. 9, e3207, 2023. https://doi.org/10.54751/revistafoco.v16n9-193.

SANTOS, M. G. et al. Neuroeducation and pedagogical practices aimed at the development of attention in the classroom. **Revista Tópicos,** Rio de Janeiro, v. 4, n. 34, p. 1-20, 2026. ISSN: 2965-6672.

SILVA, N. L. da et al. Contributions of neuroscience to pedagogical practice: how knowledge of brain functioning can enhance the teaching-learning process. **Revista de Geopolítica,** [S. l.], v. 16, n. 5, e1053, 2025. https://doi.org/10.56238/revgeov16n5-209.

SILVA, W. D. dos S.; MACÊDO, M. C.; BARBOSA, P. F. C.; MOURA, C. S. R.; MAGALHÃES, J. H. G. Digital technologies and meaningful learning: impacts through multiliteracies. **RENOTE,** Porto Alegre, v. 23, n. 1, p. 676-687, 2025. https://doi.org/10.22456/1679-1916.149313.

SOUSA, J. R. de; SANTOS, S. C. M. dos. Content analysis in qualitative research: a way of thinking and doing. **Pesquisa e Debate em Educação,** v. 10, n. 2, p. 1396-1416, 2020. ISSN: 2237-9444. https://doi.org/10.34019/2237-9444.2020.V10.31559.

WILLIAMS, J. **Stand out of our light:** freedom and resistance in the attention economy. Cambridge: Cambridge University Press, 2018.

ZILIO, C.; CRESPI, L. R. S.; NOBILE, M. F. Meaningful learning: perspectives for enhancing mathematics learning. **Saberes da Amazônia,** v. 4, n. 9, p. 31-53, 2020. https://doi.org/10.31517/rsa.v4i9.341.

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