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INNOVATION IN EDUCATION IN DIGITAL SOCIETIES

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ABSTRACT

Innovation in education is crucial for the development of contemporary digital societies, which are inherently and continually networked. This transformation does not stop at mere technological adoption; however, it requires a profound pedagogical reconfiguration and the development of multiple digital and technological literacies, as well as critical reflection on the part of teachers and students, which debunks the idea that they are digitally proficient by nature. The critical reflection presented in this article proposes a transition to active and constructivist learning models, centred on the student, in which the educator takes on new roles: content manager, creator of educational experiences and facilitator. Assessment should favour formative approaches, providing continuous feedback that promotes student autonomy. The need to tackle pressing challenges, such as the multifaceted digital divide (which goes beyond mere access to equipment), ethical issues and the promotion of digital well-being, requires a holistic and integrated approach, which must combine technological potential with a clear pedagogical vision, intentionally geared towards the integral development of all those involved.

KEYWORDS: Digital Competences, Learning Ecosystems, Education, Pedagogical Innovation, Pedagogical Models, Multiliteracies, Digital Societies.

1. INTRODUCTION

Contemporary society is indelibly marked by the omnipresence of the digital, whose transversal influence has been promoting a profound reconfiguration of social structures and human interactions, a phenomenon widely documented in the literature (e.g. Castells, 2015; Souza et al., 2023). This significant social reconfiguration is made particularly evident by the progressive dissolution of the dichotomy that traditionally separated online and offline realities, resulting in an increasingly integrated fusion of these two worlds. This process of hybridisation of existence, in turn, has a profound and multifaceted impact on the human experience, directly influencing the formation of individual and collective identity, as well as the very perception of reality (Schlemmer et al., 2020; Schlemmer & Moreira, 2020; Yun, 2023).

This systemic and comprehensive reconfiguration gives rise to new and fundamental demands that are unequivocally reflected in education systems, forcing education, as the primary institution for socialisation and skills development, to critically and thoughtfully adapt its core functions namely the curriculum, pedagogy and assessment to these new emerging realities (Redecker, 2017; Castells, 2015; Floridi, 2014, 2015; Schlemmer & Moreira, 2020; Sá et al., 2021). The inability to make such a systemic adaptation carries the substantial risk of establishing a serious disconnect between educational outcomes and societal and individual needs, a mismatch that can culminate in the training of individuals who are not adequately prepared for contemporary challenges and the consequent worsening of existing social inequalities (Sadjadi, 2023), a context in which innovation emerges as a fundamental and unavoidable requirement for social cohesion and progress (Méndez-Domínguez et al., 2023).

As a result, educational innovation must not be presented merely as a desirable option, it must be affirmed, with increasing urgency, as a pressing need. Inaction or stagnation on the part of education systems does not represent a neutral stance, but rather a decision with actively negative and damaging consequences (Sailer et al., 2021a). Persistence in obsolete models not only represents a missed opportunity to advance education but also actively adds to the exacerbation of complex social problems, such as the inadequacy of the workforce in the face of new market demands and the deepening of social divides and inequalities (van Dijk, 2020; Sá et al., 2021).

In this scenario, educational innovation in the digital age is configured as a complex interaction between pedagogical designs and the vast technological potential, opposing a vision of purely technological determinism and requiring a profound reconfiguration of competences, pedagogies, and assessment methods (Sailer et al., 2021a; Redecker, 2017; Moreira et al., 2020). It is, therefore, pivotal to focus on the development of digital, technological, and, crucially, critical literacies for both teaching staff and students (Martin, 2006). This effort involves demystifying the simplistic notion of "digital natives" (Bennett et al., 2008) and underlines the need for personalised and continuous training paths (Loureiro et al., 2021) because, as has been shown, critical literacy is the foundation for conscious participation in the infosphere (Williams, 2022). The effectiveness of technology in the educational context ultimately depends not on the tool itself, but on the reasoned, reflective, and critical intentionality of educators, whose pedagogical agency is decisive (Sailer et al., 2021a, 2021b; Moreira et al., 2020). This transformation entails an evolution in the role of the educator, moving away from a model of vertical transmission (Tonucci, 1993) to embrace a more active and facilitative approach (Salmon, 2002), a change that has been analysed by several authors (Ahlquist, 2014; Ott & Hoelscher, 2023; Redecker, 2017).

This study aims to carry out an in-depth and detailed analysis of the multiple and interconnected aspects of this pedagogical reconfiguration, addressing specifically the nature of digital societies, the need for new skills and literacies, the complex configuration of learning ecosystems, the most effective digital assessment strategies and the critical challenges that accompany this inevitable transition, culminating in the presentation of conclusions and recommendations for educational practice and future lines of research. To this end, this article uses a literature review methodology that combines theoretical frameworks with the results of recent, relevant research. This approach enables us to provide a comprehensive, robust, and justified analysis of educational innovation in the digital age.

2. EDUCATION IN DIGITAL SOCIETIES

For an in-depth understanding of the contemporary educational context, a detailed analysis of its environments is indispensable (Bronfenbrenner, 1987). The concept of digital societies refers to collectivities that are profoundly shaped by digital infrastructures and continuous flows of information (Castells, 2015; Schlemmer & Moreira, 2020). These communities are distinguished by characteristics such as hyperconnectivity, the

extensive digitisation of everyday life, and a notable dissolution of the boundaries that traditionally separated the physical and virtual realms. This phenomenon has a profound impact on the human experience, the construction of identity, social interaction, and the very perception of reality (Floridi, 2014, 2021; Schlemmer et al., 2020), giving rise to new and complex ethical dilemmas, such as data privacy and algorithmic bias (Mhlongo et al., 2023; Yun, 2023).

The educational implications of this paradigm are vast and transformative, as learning is no longer confined to physical spaces or specific moments but rather has the potential to become ubiquitous and continuous (Sangrà, 2022). Consequently, the role of formal education is being reconfigured, shifting from its traditional role as the main provider of knowledge to fulfilling the mission of equipping learners with the necessary skills to manage, interpret, and interact ethically with the constant flow of information (Moreira et al., 2020; Redecker, 2017). This new reality emphasises the importance of skills such as critical digital literacy, self-regulation in online environments and ethical decision-making, which are becoming just as relevant, if not more so, than subject-specific knowledge (Williams, 2022). In this way, learning is evolving from a discrete event to a process that is fully integrated into life (Dias-Trindade, 2020), challenging formal education to focus less on the transmission of a fixed body of knowledge and more on the development of "meta-skills" such as learning to learn, critical thinking, and adaptability that prepare individuals for a life of continuous learning in a hybrid reality (Sá et al., 2021), where the ability to constitute themselves as producers and critics of knowledge becomes a central objective (Nieminen et al., 2024).

The repercussions on teaching have a great magnitude, demonstrated through the demand for new skills, changes in student expectations, and the need for educational institutions to act more effectively in a digital context, which makes it possible to personalise learning (Martin, 2006; Sá et al., 2021). This scenario raises unavoidable critical questions related to the ownership and ethical use of data, as well as the potential for surveillance and the introduction of algorithmic biases in decisions that affect students (Bearman et al., 2023; Mhlongo et al., 2023; Sadjadi, 2023).

Despite the immersion in digital, there is a growing tension, evidenced by movements that advocate a more pondered use of technologies, which highlights the critical need to develop not only digital skills, but also skills of "digital wellbeing" and managing the relationship with technology (Meyerhofer-Parra & González-Martínez, 2024; Redecker, 2017). In this way, issues such as privacy, the right to disconnect, and the impact of hyperconnectivity on mental health and social relationships have become particularly pressing and unpostponable subjects for analysis (Yun, 2023).

3. KEY SKILLS AND LITERACIES IN THE DIGITAL AGE

The transition to contemporary digital societies requires a renewed, in-depth focus on developing a robust set of competences and literacies for both educators and students, empowering them for successful participation in today's complex and interconnected environments (Dias-Trindade & Gomes Ferreira, 2020; Redecker, 2017; Sá et al., 2021).

In this context, teachers' digital competence transcends mastery of a specific tool; rather, it consists of the ability to integrate technologies thoughtfully, critically, and effectively into all aspects of professional practice (Sailer et al., 2021a). This premise requires educators to be able not only to design and implement the use of digital resources in the various phases of a learning activity (Lohr et al., 2021), but also, regarding artificial intelligence tools, to develop the ability to create, evaluate, and manage them ethically and responsibly (Mhlongo et al., 2023). Consequently, the role of the teacher with high digital skills evolves from that of a mere transmitter of information to that of a mentor and advisor who designs enriched educational paths, provides personalised assistance to students and actively promotes collaborative and self-regulated learning activities (Redecker, 2017; Salmon, 2002).

The development of these complex competences does not occur instantaneously but progressively, and is the result of continuous practical experience, systematic reflection and a commitment to ongoing professional development throughout life (Fissore et al., 2020). Given that educators start their careers with very different levels of competence and rates of progression, it is paramount that institutional support is sustained and differentiated, rather than limited to one-off, generalised training actions that prove insufficient (Loureiro et al., 2021). Educational institutions should, therefore, strive to create professional development ecosystems that offer personalised paths, ongoing support, and opportunities for sharing, such as coaching programmes or the promotion of communities of practice (Dias-Trindade & Gomes Ferreira, 2020; Economou et al., 2023; Palacios-Rodríguez et al., 2023).

The urgency of this training is corroborated by various studies, both national and international, which converge in identifying a persistent need to deepen teachers' digital skills (Andaluz-Delgado et al., 2023; Fissore et al., 2020; Loureiro et al., 2021). The Portuguese reality, including the specific context of the Autonomous Region of the Azores, where a considerable number of teachers still lack specific training in this area, is perfectly in line with this global trend (Loureiro et al., 2024). Furthermore, teachers' digital proficiency tends to vary significantly depending on the subject area taught (Vieira et al., 2023), which highlights the need for training to transcend the mere instrumental use of tools and focus instead on developing a specific "digital didactic" adapted to each teaching context (Sailer et al., 2021a). In this way, teachers' individual responsibility for their own training must be complemented by a clear institutional and political responsibility for creating and offering flexible, personalised, and universally accessible training pathways (Dias-Trindade & Gomes Ferreira, 2020; Palacios-Rodríguez et al., 2023).

In parallel and complementary to teacher training, it is equally important to develop students' digital skills to ensure their educational success in the digital age (Angelova & Nikolova, 2024). For years, it was assumed that young people had an innate technological proficiency, an idea popularised by the concept of the "digital native" (Prensky, 2001). However, this notion has been widely criticised and debunked by empirical research, which shows that young people's digital practices are often superficial and that their skills are not uniformly developed, but are instead strongly influenced by variables such as the formal and informal learning experiences to which they have been exposed (Bennett et al., 2008; Kirschner & De Bruyckere, 2017; Guzmán-Simón et al., 2017; Pais et al., 2023; Silveira, 2019; Vodă et al., 2022).

Demystifying this concept of the "digital native" is, therefore, crucial, as it shifts the responsibility for developing critical literacy skills from assumptions about students to educational institutions, exposing a pedagogical gap that can only be bridged through explicit and intentional instruction (Bennett et al., 2008). If students lack intrinsic skills in vital areas such as the critical evaluation of sources, the operation of algorithms, or digital ethics (Valverde-Crespo et al., 2020), then it is clear that these skills must be taught transversally and integrated into the curriculum (OECD, 2021; Redecker, 2017). Ignoring this gap, based on the illusory premise of an innate ability, results in students acting as mere passive consumers of content, rather than becoming critical and creative producers (Guzmán-Simón et al., 2017), and fosters a digital citizenship that is more fragile and vulnerable to disinformation and other online risks (Sá et al., 2021).

The skills that students truly need to thrive include critical information literacy, data literacy, and active and responsible digital citizenship (Angelova & Nikolova, 2024; OECD, 2021). There is often a significant discrepancy between the skills developed by young people in their informal contexts, frequently linked to leisure and socialisation, and those that are valued and required in formal academic and professional contexts (Guzmán-Simón et al., 2017; Silveira, 2019). However, this gap should not be seen as an obstacle, but rather as a pedagogical opportunity for the school to capitalise on this informal learning, integrating it critically and reflexively into the formal curriculum (Linnéa et al., 2022). Indeed, the relationship between teacher and student literacy is symbiotic, as educators who have well-developed critical literacy skills are clearly better equipped and able to foster these same skills in their students (Redecker, 2017).

In today's intrinsically networked society, the very concept of literacy has expanded beyond its traditional definition, evolving into a complex set of "multiliteracies" that are deemed fundamental for exercising full and informed citizenship (The New London Group 1996). Operational definitions of multiliteracy include the ability to construct meaning through various media, such as text, images, sounds, space, and gestures. It also involves the capacity to navigate between these forms of media while recognising their respective conventions (Cope & Kalantzis, 2000). In other words, multiliteracy provides a more comprehensive view of literacy by recognising the variety of channels and cultural diversity that cannot be overlooked in education (Kalantzis et al., 2020). This approach is crucial in teacher training, as Guichot-Muñoz et al. (2020) point out; combining these channels can enhance the learning experience. Yelland (2018, p. 856) reinforces this idea, stating that "the main difference about learning in the 21st century is not that it is digital, but that it is multimodal. Being able to select the most effective modalities to represent your idea or communicate your conclusions is an essential component of being multiliterate in contemporary times". This represents a necessary evolution of the classic notion of literacy, which, historically centred on reading, writing and calculation skills (Ferreiro, 2001), had to be expanded to explicitly incorporate

the digital and technological dimensions (Martin, 2006). However, the multiliteracies perspective goes beyond the sheer addition of new skills, requiring a profound reconceptualization of the very nature of communication and knowledge representation in a multimodal world (The New London Group, 1996; Rowsell & Walsh, 2012). Therefore, in this context, education must enable individuals not only to consume and interpret information, but also to become active creators of meaning through a diversity of processes and platforms (Moreira, 2021).

Within this broad conceptual framework, three literacies emerge that are absolutely fundamental: digital literacy, technological literacy and critical literacy (Williams, 2022). As defined by Martin (2006), digital literacy can be understood as the ability to use digital resources to access, manage, evaluate and create knowledge effectively, while technological literacy, in turn, refers to the ability to use these same resources according to well-defined purposes, going beyond merely instrumental or mechanical use. However, it is critical literacy that takes on a truly foundational role, by enabling individuals to analyse the torrent of information disseminated by the media with an informed, questioning "lens" that is aware of the underlying mechanisms of power and bias (Williams, 2022). The emphasis on critical literacy is particularly vital in the age of "abundant information", functioning as an indispensable cognitive mechanism for filtering, validating, interpreting and ethically discerning content (OECD, 2021). This should not be seen as an additional or optional competence, but rather as the foundation that allows the other literacies to be exercised with agency, responsibility and purpose (Schlemmer et al., 2020). While digital and technological proficiency provides the operational skills to act in the digital world, critical literacy provides the ability to question, evaluate and deeply understand the information found in these environments (Williams, 2022), transforming the individual from a mere user of tools into a conscious, reflective and intentional builder of knowledge (Nieminen et al., 2024). The synergistic convergence of these three literacies is, therefore, a fundamental element in guaranteeing conscious and active civic and social participation, not only in terms of the critical consumption of information, but also, and increasingly, in the responsible production and sharing of digital content (Moreira et al., 2020). Ultimately, the condition of being a fully literate person in the 21st century, in its multiple and interconnected dimensions, implies having the ability to think critically and creatively, to effectively and autonomously manage information resources and to contribute constructively to building a fairer, more equitable and more proactive society (Farias, 2022; Méndez-Domínguez et al., 2023; OECD, 2021).

4. PEDAGOGICAL RECONFIGURATION IN DIGITAL CONTEXTS

The inescapable digital transformation that permeates contemporary society is driving a profound and necessary re-evaluation of current pedagogical models, giving unequivocal priority to approaches that not only enhance the intrinsic characteristics of digital learning environments, but also respond effectively to the complex needs of learners immersed in "OnLife" contexts, where the boundaries between the physical and the virtual are continually blurring (Schlemmer & Moreira, 2020). This fundamental reconfiguration implies a paradigmatic transition away from traditional models, often centred on the figure of the teacher as a mere transmitter, towards more active, dynamic and constructivist pedagogical models, in which the student is positioned as the central protagonist of their own learning process (Coll, 1994; Sioukas, 2023). Indeed, constructivist and socio-constructivist theories, which postulate knowledge as an active, personal and socially mediated construction, find particularly fertile ground in digital environments, which, due to their interactive and connected nature, can facilitate active learning, peer collaboration and the co-creation of knowledge in an extraordinary way (Barros, 2023; O'Connor, 2022). Despite the vast transformative potential, simply transposing the most conservative and transmissive teaching models to the new technological scenarios remains a recurring and significant challenge. This phenomenon often prevents the achievement of true pedagogical innovation (Dotta et al., 2019). As Francesco Tonucci's (1993) famous illustrations acutely demonstrate, technology can be integrated into the physical space of the classroom without any substantial transformation taking place in the underlying teaching model, with the role of the teacher as the main speaker and transmitter of a static body of knowledge remaining intact. The persistence of these transmissive models, even in environments that have been digitally enriched with the most diverse tools, conclusively suggests that the introduction of digital artefacts alone does not guarantee the desired and necessary pedagogical innovation (Sailer et al., 2021a). Rather, research advocates that teachers' pedagogical skills and their ability to orchestrate meaningful learning experiences prove to be much more decisive for the

quality of learning than the mere availability of advanced technological resources (Sailer et al., 2021a). Despite widespread recognition of the theoretical suitability of constructivism for digital learning environments (O'Connor, 2022), its effective and widespread implementation is considerably hampered by this persistent tendency to replicate old pedagogical practices in new settings (Dotta et al., 2019). This critical disconnect between theoretical potential and actual practice, which Tonucci (1993) already pointed out, emphasises that true educational transformation requires a profound paradigmatic shift in the very conception of what it means to teach and learn, a process that is intrinsically linked to the need for teacher training focused fundamentally on developing effective digital pedagogies and not just on acquiring instrumental skills to operate technology (Redecker, 2017). This transition implies, therefore, a shift in focus away from the traditional dichotomy between "teaching" and "learning" (Tonucci, 1993), towards a genuine appreciation of the idiosyncratic learning processes of students, who, as Emilia Ferreiro (2001) reminded, do not ask permission to begin their journey of knowledge construction. In this sense, a conscious transition from the "transmissive school" to a "constructive school" is advocated, in which the student takes on an undeniably active and central role in the construction of meaning (Tonucci, 1993), with the ultimate goal of pedagogical intervention becoming the development of the capacity to "learn how to learn", enabling students to carry out significant learning on their own in a wide range of situations and contexts throughout their lives (Coll, 1994; Farias, 2022). This new paradigm, which emphasises students as the active builders of their own knowledge (Coll, 1994; O'Connor, 2022), consequently makes the traditional role of the teacher as the sole holder and transmitter of knowledge obsolete (Tonucci, 1993). In a contemporary context, where digital environments offer direct and immediate access to an abundance of information and powerful creative tools (Barros, 2023; Campos, 2023), the role of the educator has been substantially redefined. On the one hand, the figure of the teacher emerges as a curator of content, who helps students to critically navigate the vastness of information, assign meaning to it and develop their critical literacy (Williams, 2022). Furthermore, the educator is increasingly seen as a maker, a facilitator who moulds and promotes the creation of knowledge by students, rather than merely transmitting it passively (Moreira, 2017), which implies creating and adapting dynamic learning materials and fostering a "maker mentality" among students (Barros, 2023). This profound transformation of authority requires a significant identity change on the part of teachers, as well as the development of new and sophisticated skills in facilitation, resource management and the promotion of student autonomy (Redecker, 2017; Salmon, 2002). This transition can be particularly challenging, as it requires educators to cede control, learn to manage uncertainty and be willing to continuously learn from their students (Dotta et al., 2019), always ensuring that technological integration is intentional and guided by sound pedagogical principles (Moreira et al., 2020; Sailer et al., 2021a).

5. ECOSYSTEMS AND INNOVATIVE DIGITAL LEARNING ENVIRONMENTS

Education in the digital age is not limited to the simple use of isolated technological tools; rather, it is configured in a much more complex and comprehensive way as a "digital education ecosystem" (Moreira, online). It is a dynamic, interactive system comprising three key elements: actors (students, teachers and administrators); resources (content, platforms and hardware); and institutional policies and pedagogical strategies. Together, these elements create and sustain flexible, personalised learning environments (Moreira, online; Mhlongo et al., 2023; Sailer, Murböck & Fischer, 2021a). Inspired by the ecological models of human development proposed by Bronfenbrenner (1987), this perspective conceptualises digital education as an intricate web of technological components, content resources, learning platforms, human actors, institutional policies and pedagogical strategies, all interacting dynamically to create rich, flexible and adaptive learning environments (Dias Trindade, 2020; Mhlongo et al., 2023). Consider, for example, a project-based learning initiative in a secondary school in which students investigate a local environmental issue. In a successful digital ecosystem, they could use collaborative online tools, such as Google Workspace or Microsoft Teams, to manage the project, as well as access scientific databases via the school's digital library. They could also use specialised software to create environmental impact simulations and produce a multimedia documentary to present their findings to the community. According to Nieminen and collaborators (2024), the seamless integration of digital resources, pedagogical guidance and authentic learning objectives is essential. The effectiveness of such an ecosystem comes precisely from its ability to coherently and synergistically articulate different environments, following a logic of

hybridisation that fluidly blends physical and digital learning spaces (Sangrà, 2022). In this systemic framework, the success of any digital ecosystem depends fundamentally on the harmonious and synergistic interaction between its key elements namely, resources, teachers and students (Moreira, online; Schlemmer & Moreira, 2020). The implementation of a new technology without corresponding and adequate teacher training (Loureiro et al., 2021), without careful consideration of the needs and contexts of the students (Guzmán-Simón et al., 2017), or without the support of clear and supportive institutional policies, will predictably result in its underutilisation or even failure (Yun, 2023). For technological implementation to be of high quality, it is crucial to ensure the cohesive articulation of three interdependent dimensions: the organisational dimension, which encompasses leadership and change management; the pedagogical dimension, which refers to the teaching capacity to design and ensure the quality of learning experiences; and the technological dimension, which encompasses infrastructure, resources and technical support (Moreira, online; Sailer et al., 2021a). In the technological context of this ecosystem, Artificial Intelligence (AI) is becoming increasingly important, with immense potential to profoundly reconfigure pedagogical strategies and personalise learning (Mhlongo et al., 2023; Sadjadi, 2023). Their successful integration requires educators to develop new skills to interact with AI systems, critically evaluate their resources and results, and implement responsible and ethical management of their use in the classroom (Redecker, 2017). In turn, students urgently need to develop AI literacy, which enables them not only to understand the basic workings of algorithms but also to critically evaluate AI-generated content and collaborate effectively and ethically with these new tools (Floridi, 2014; OECD, 2021). In this new scenario, the role of the educator is undergoing further transformation, taking on the crucial roles of knowledge mediator and ethical advisor in this new and complex human-machine interaction (Salmon, 2002). The landscape of learning environments is also continually being enriched by other emerging technologies, such as Virtual Reality (VR), Augmented Reality (AR) and the Metaverse concept, which promise to create significantly more engaging, immersive and experiential learning opportunities (Goulart, 2022; Tori, 2023). However, the history of educational technology suggests that the hype around these innovations may simply repeat previous cycles of technological hype if their adoption is not firmly anchored in sound pedagogy and clear intentionality (Dotta et al., 2019; Yun, 2023). Mere student involvement alone is no guarantee of learning; the immersive experience must be carefully designed and intentionally structured to achieve specific and well-defined educational goals (Barros, 2022). Moreover, the high cost and limited accessibility of these cutting-edge technologies can generate or deepen new and worrying digital divides among students (van Dijk, 2020). Consequently, financial investment in emerging technologies must always be accompanied by a proportional and equally robust investment in pedagogical design, teacher professional development and the creation of infrastructures accessible to all (Goulart, 2022; Moreira et al., 2020). Social networks, whose ubiquitous presence is felt in almost every aspect of daily life, also have considerable potential to support the building of learning communities and the dynamic sharing of knowledge (Souza et al., 2023). However, they carry significant risks, such as spreading misinformation and promoting distraction (Yun, 2023). Connectivism, as a learning theory for the digital age (Dias-Trindade, 2020; Siemens, 2005), provides a valuable conceptual framework for understanding and taking pedagogical advantage of these networks, emphasising the ability to navigate, filter and contribute to distributed knowledge networks. Optimising the potential of these networks for learning requires a modification of the traditional mindset and the creation of spaces that creatively articulate formal and informal learning, while promoting the development of essential digital citizenship skills (Redecker, 2017). Ultimately, designing truly effective digital learning experiences depends on our ability to create meaningful and engaging "e-activities" (Barros, 2023; Campos, 2023). As defined by Barros (2023), an e-activity, understood as any activity with an educational purpose that uses digital technologies, should be characterised by pedagogical intentionality, personalisation, collaboration and formative assessment, among other principles, to ensure that technology serves to enrich and support learning processes and not just as a modern prop (Moreira et al., 2020).

6. DIGITAL ASSESSMENT FOR MEANINGFUL AND AUTHENTIC LEARNING

Assessment is a critical element of the educational process, whose transition to digital environments requires careful and in-depth reflection on its methods, purposes and instruments, to ensure that it promotes learning that is both meaningful, authentic and geared towards the development of complex and lasting skills (Bearman et al., 2023). In this context, the classic distinction between formative assessment, also known as assessment for learning, and summative assessment, or assessment of learning, remains

relevant, although its potential has considerably increased in the digital context (Santos, 2016). While formative assessment, which has a continuous and guiding nature, takes place throughout the learning process with the primary purpose of providing timely feedback for the development of both students and teaching practices (Machado, 2020, 2021), summative assessment, which is more occasional in nature and often classificatory, is carried out at the end of a unit of work or course to gauge the proficiency achieved at a given time (Santos, 2016). Digital tools have enormous potential to enhance both types of assessment, from interactive quizzes and discussion forums to e-portfolios, which serve as excellent examples of their application in formative assessment contexts (Grosseck et al., 2024; Santos & Simões, online). However, the unique potential that digital environments offer to make formative assessment more continuous, personalised and data-driven is, regrettably, often underused (Bearman et al., 2023; Machado, 2020). Common practice reveals a worrying tendency to merely transpose traditional summative methods, such as multiple-choice tests, into an online format, without reconfiguring their purpose or methodology (Grosseck et al., 2024). This underuse can be causally linked to the persistence of transmissive teaching models (Tonucci, 1993) and a deeply rooted assessment culture centred on students' grading and ranking (Santos, 2016), which, in turn, hinders the transition to genuinely student-centred pedagogies (Coll, 1994). Realising the transformative potential of digital assessment, therefore, requires a significant cultural and pedagogical shift towards valuing, designing and implementing formative feedback cycles that are continuous, rich and dialogued (Grosseck et al., 2024; Machado, 2021). In this sense, feedback plays an absolutely central role in the entire assessment process, especially in its formative aspect (Machado, 2021), and is essential for identifying students' specific needs and providing constructive guidance that allows for timely adjustments to both teaching strategies and learning processes (Machado, 2020). Its importance is particularly pronounced in distance or hybrid teaching contexts, and should be enhanced through an intelligent combination of synchronous and asynchronous communication technologies to ensure that the pedagogical dialogue remains lively and effective (Moreira et al., 2020). In parallel with the primacy of feedback, authentic assessment is emerging as a fundamental approach for the 21st century, focusing on the application of knowledge and skills in complex tasks and meaningful contexts that are analogous to those found in the real and professional world (Wiggins, 1990), thus seeking to establish a vital link between school activity and young people's everyday lives (Oliveira & Pereira, 2021). Despite the challenges inherent in its implementation, such as the difficulty of large-scale application or guaranteeing academic integrity (Oliveira & Pereira, 2021), its relevance is crucial for developing the complex skills required by contemporary digital societies (Sá et al., 2021). However, genuine assessment must not be limited is not limited to the mere simulation of professional tasks or an excessive focus on so-called "employability skills", a view that is often considered reductive and instrumentalist of the purpose of education (Nieminen et al., 2024; Wiggins, 1990). Its deeper and more transformative purpose should be to promote students' epistemic agency, enabling them to become not just consumers of information, but critical builders and users of knowledge (Nieminen et al., 2024), since today's society requires, more than technical skills, the ability to solve complex problems and contribute ethically to the production of new knowledge (OECD, 2021). In this sense, the design of authentic assessment should challenge students to investigate, create, reflect and justify their positions, aiming at developing citizens capable of thinking critically, autonomously and independently (Nieminen et al., 2024; Wiggins, 1990; Bearman et al., 2023; Amante et al., 2014; Moreira et al., 2020). However, while the increasing use of AI-based assessment tools shows promise, these tools have significant limitations that require critical analysis (Kearns & Roth, 2019). Firstly, there is a substantial risk of algorithmic bias, as AI systems trained using historical data can perpetuate or exacerbate existing inequalities relating to gender, ethnicity or socioeconomic status. Secondly, the validity of these tools is often questionable: they excel at measuring the correctness of structured tasks, but struggle to evaluate complex skills such as creativity, critical thinking, and ethical collaboration. Thirdly, scalability issues can result in depersonalised feedback, which undermines the formative and relational aspects of assessment (Martinez-Comesana et al., 2023; Xia et al., 2024).

7. ETHICAL CHALLENGES, EQUITY AND WELL-BEING IN DIGITAL EDUCATION

The growing integration of digital technologies into the teaching and learning process raises various pressing and unavoidable challenges, particularly regarding equity, inclusion, data privacy and the general well-being of learners (Yun, 2023). Overcoming these obstacles is crucial to ensuring that digital innovation serves genuinely humanistic purposes and promotes a fairer and more equitable future for all (Sá et al., 2021). In this context, digital

exclusion emerges as a particularly multifaceted issue, which far transcends the simplistic question of access to devices and internet connectivity (van Dijk, 2020). In line with the solid theoretical foundation of authors such as van Dijk (2020), digital exclusion encompasses much deeper and more subtle dimensions, namely the lack of digital skills to use technology effectively (the second level of exclusion) and the lack of opportunities for meaningful and transformative use of technology (the third level). Digital transformation can, paradoxically, can both exacerbate and mitigate these social asymmetries, depending critically on how it is planned, implemented and managed (Méndez-Domínguez et al., 2023). Effectively tackling digital exclusion, therefore, requires systemic and holistic interventions. Simply providing hardware, such as computers or tablets, is clearly insufficient, as the levels of exclusion associated with developing skills and promoting meaningful use are often more persistent and difficult to overcome than the initial gap in access to equipment (van Dijk, 2020). Indeed, access alone has a very low impact without the parallel development of skills (the second level) and the creation of pedagogical contexts for relevant and enriching application (the third level) (Nguyen et al., 2020). Ignoring these deeper dimensions of exclusion can induce an illusory sense of progress, while disparities in educational and social outcomes persist or even widen (van Dijk, 2020). Digital inclusion policies must, therefore, be comprehensive, integrating investment in infrastructure with robust skills development programmes for students and teachers, with the creation of relevant and culturally sensitive digital content, and with the design of digital pedagogies that are intrinsically inclusive (Méndez-Domínguez et al., 2023). Digital equity is by no means merely a technical or resource issue, but is fundamentally socio-pedagogical in nature and requires constant attention (Sailer et al., 2021a). The way student data is collected, used and protected raises pressing ethical questions that require in-depth analysis if technological advances are to be truly inclusive and sustainable in the long term (Sadjadi, 2023). Data privacy, in particular, is a central and non-negotiable concern in the age of digital education (Floridi, 2014). This challenge is exacerbated by the complexity of the global regulatory landscape (Giuffrida & Hall, 2023). The General Data Protection Regulation (GDPR) in Europe, for example, establishes an extensive and rigorous framework for protecting personal data, granting individuals substantial rights over their data. In contrast, the Family Educational Rights and Privacy Act (FERPA) in the United States takes a more sector-specific approach, focusing on safeguarding educational records, albeit with a different scope. These differences underscore the difficulty of developing educational technologies and policies that are ethically sound and globally compliant. At the same time, the active promotion of "Digital Wellbeing" within school communities is a categorical imperative (Meyerhofer-Parra & González-Martínez, 2024). This new reality imposes the need to foster healthy habits in the use of technology, to seek a sustainable balance between online and offline life, and to proactively and systematically address harmful phenomena, such as cyberbullying, information overload and the impacts of hyperconnectivity on the mental health of students and educators (Redecker, 2017; Yun, 2023). Furthermore, it must be acknowledged that there is an inherent tension and a fundamental ethical dilemma between the drive to personalise education, which is increasingly data-driven, and the imperative to protect students' privacy and autonomy (Floridi, 2014). The promise of AI and learning analytics to offer highly personalised and adaptive learning experiences requires, by definition, the collection and analysis of large volumes of student data (Mhlongo et al., 2023). However, inadequate or non-transparent management of this process can result in serious breaches of privacy, the establishment of an intrusive surveillance culture in schools, or the creation of student profiles that, instead of opening doors, end up limiting their future opportunities (Bearman et al., 2023). Navigating this complex tension requires the development of robust ethical frameworks, the implementation of transparent data policies and the adoption of a "privacy by design" approach in the development of educational technologies (Floridi, 2014). The broader implication of all this lies in the need for an informed and ongoing public debate about the ethical limits of data collection and use in the educational context, always keeping the well-being, dignity and agency of the learner as the top priorities (Meyerhofer-Parra & González-Martínez, 2024).

8. CONCLUSION AND RECOMMENDATIONS

The effective transformation of education in response to the imperatives of digital societies requires an approach that is both multifaceted, integrated and ethically aware, focused on building robust, flexible and adaptable digital education ecosystems (Sá et al., 2021; Schlemmer et al., 2020; Moreira, n.d.; Redecker, 2017; Bearman et al., 2023; van Dijk, 2020; Floridi, 2014; Méndez-Domínguez et al., 2023). The preceding

analysis has explored in detail the immense potential of digital learning ecologies (Dias Trindade, 2020), which range from emerging technologies such as AI and the metaverse (Tori, 2023) to the judicious pedagogical use of social networks (Souza et al., 2023), consistently warning of the persistent challenges of equity (van Dijk, 2020) and the absolute need for pedagogical intentionality to guide any innovation (Sailer et al., 2021a). As has been shown, the meticulous design of electronic activities or e-activities is pivotal for effective learning (Barros, 2023), as is harnessing the potential of audio-visual language (Moreira, 2021) and the pressing need to rethink assessment with a clear focus on feedback for learning (Machado, 2021).

The real ability to prepare education for the future lies not in the futile attempt to predict specific technological futures, which are, by nature, ephemeral and unpredictable (Yun, 2023), but in the systematic cultivation of the adaptive capacity of individuals, institutions and educational systems themselves (Sá et al., 2021). The most enduring and fundamental need is to develop in all citizens the competence to learn, unlearn and relearn throughout their lives, critically evaluating new tools, methodologies and approaches as they emerge (Williams, 2022). Consequently, the ultimate purpose of digital innovation in education is not to achieve a final, static state of technological perfection, but to foster dynamic resilience and a culture of continuous improvement in the face of constant and unpredictable change (Sadjadi, 2023).

Based on the above in-depth analysis, a set of crucial recommendations is outlined to ensure the sustainability and positive impact of digital innovation in education. Regarding educators, it is imperative to invest in their continuous professional development, not only technical but, above all, pedagogical, encouraging the adoption of new roles, such as maker and content manager (Moreira, 2017), and the implementation of rigorous ethical practices that favour the students' privacy and integral well-being (Floridi, 2014; Meyerhofer-Parra & González-Martínez, 2024). For their part, educational institutions must take responsibility for creating and maintaining robust digital education ecosystems, equipped with adequate infrastructure and technical and pedagogical support (Moreira, online), as well as implementing clear and transparent policies for data governance and the ethical use of AI (Bearman et al., 2023), actively fostering a culture of innovation, experimentation and collaboration among their professionals (Sailer et al., 2021b). Ultimately, within policy-making bodies, it is critical to develop comprehensive national strategies that tackle the various facets of digital equity head-on (van Dijk, 2020) and that support research into the development and implementation of pedagogically sound, evidence-based solutions (Sadjadi, 2023; OECD, 2021).

The successful implementation of the aforementioned recommendations requires shared responsibility and concerted effort, since no single actor will be able to bring about the systemic transformation that is needed (Sailer et al., 2021a; Yun, 2023). Success depends on strategic alignment and robust collaborative partnerships between the individual (educators and students), the institutional (schools and universities) and the political (governments and regulatory agencies) levels (Palacios-Rodríguez et al., 2023; Sá et al., 2021). Given the extremely dynamic and evolving nature of this area, various rich opportunities for future research are identified, including longitudinal studies on the long-term impact of teacher training in digital pedagogies, research into the development of critical thinking in immersive environments and in-depth analyses of the ethical and pedagogical implications of AI in assessment processes (Loureiro et al., 2021,2024; Goulart, 2021; Tori, 2023; Mhlongo et al., 2023; Amante et al., 2014; Oliveira & Pereira, 2021).

In short, innovation in digital education is not an unavoidable inevitability but rather a continuous process of critical reflection, informed experimentation and constant adaptation, through which, by facing challenges with discernment and pedagogical intentionality, it is possible to build educational futures that are genuinely more inclusive, equitable and empowering for all (Sá et al., 2021).

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