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School life, sense of belonging, and learning: The role of collaborative practices, ICT, and chatbots

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Abstract

School life constitutes a multidimensional psychosocial context in which learning is inextricably linked to students' emotional engagement, participation, and sense of belonging. This study investigates the factors that contribute to the creation of supportive and inclusive school environments, with particular emphasis on collaborative practices, Information and Communication Technologies (ICT), and artificial intelligence tools such as chatbots. Learning engagement is conceptualized as a multidimensional phenomenon encompassing cognitive, emotional, and behavioral dimensions, while the sense of belonging emerges as a pivotal factor in enhancing student participation and well-being. The study further examines the role of school climate, teacher–student relationships, and pedagogical practices in shaping positive learning experiences. Particular attention is devoted to the contribution of ICT and digital tools in facilitating differentiated instruction, fostering interaction, and promoting active student participation. Additionally, chatbots and artificial intelligence applications are explored as innovative learning support instruments that advance personalization and self-regulation. The findings indicate that the integration of collaborative and digital practices contributes to the formation of a modern, inclusive, and dynamic school environment in which a sense of belonging is strengthened and meaningful student engagement is promoted

Keywords: School Climate; Sense of Belonging; Learning Engagement; Collaborative Learning; ICT; Artificial Intelligence; Chatbots; Inclusion; Digital Education

1. Introduction

School life extends well beyond the transmission of academic content, constituting a complex psychosocial environment within which attitudes, identities, and modes of participation are shaped. Each school functions as a space for interaction, emotional engagement, and social integration, where the prevailing climate decisively influences students' overall experience (Eccles and Roeser, 2011). Of particular significance is the sense of belonging, which has been consistently linked to academic engagement and the maintenance of active participation in the educational process (Goodenow, 1993; Wang andDegol, 2016).

Student engagement is increasingly understood as a multidimensional phenomenon that transcends the behavioral dimension to encompass emotional and cognitive facets. Strengthening engagement is associated with elevated levels of well-being, feelings of security, and a sense of meaning within the school experience (OECD, 2017). Concurrently, the cultivation of supportive and inclusive learning environments contributes to educational equity and ensures the active involvement of all students, irrespective of individual differences (UNESCO, 2017).

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A comprehensive understanding of the relationship between belonging, engagement, and learning therefore necessitates a holistic approach that integrates psychological, pedagogical, and social perspectives, foregrounding the dynamic interplay between the individual and the collective (Fredricks et al., 2019). This study accordingly addresses both the theoretical foundations of these phenomena and the psycho-pedagogical parameters and practices that shape them within and beyond the classroom.

Aim and Research Questions

The aim of this study is to develop an integrative theoretical framework that examines the interrelationship between school climate, sense of belonging, and learning engagement, with a particular focus on the role of collaborative practices, Information and Communication Technologies (ICT), and artificial intelligence in fostering inclusive and student-centered learning environments.

In this context, the study seeks to address the following research questions:

- RQ1: How does school climate influence students' sense of belonging and learning engagement?
- RQ2: What is the role of collaborative and student-centered practices in fostering engagement and inclusion?
- RQ3: How do Information and Communication Technologies (ICT) contribute to enhancing participation, emotional well-being, and differentiated learning?
- RQ4: In what ways can artificial intelligence and chatbots support personalized, inclusive, and engaging learning environments?

2. Theoretical framework

Engagement in the learning experience, as a multidimensional and dynamic construct, encompasses behavioral, emotional, and cognitive dimensions. The behavioral dimension concerns participation in activities and active presence in the learning process. The emotional dimension relates to experiences of interest, acceptance, and connection with the school environment, while the cognitive dimension pertains to effort investment, strategic thinking, and deep processing of knowledge (Fredricks et al., 2004; Fredricks et al., 2019). The interaction among these dimensions highlights student engagement as a determining factor for academic performance and sustained involvement (Simos et al., 2026a; Simos et al., 2026b; Wang andDegol, 2016).

Central to this framework is the concept of self-perception and self-efficacy. Children's and adolescents' perceptions of their abilities substantially influence their levels of motivation and persistence. Positive beliefs about competence are associated with increased engagement and willingness to undertake cognitive challenges, while negative self-perceptions may lead to disengagement and reduced participation (Bandura, 1997; Jansen et al., 2015; SkaalvikandSkaalvik, 2018). The formation of such perceptions is embedded within a broader developmental trajectory in which the school environment functions as a critical socio-cognitive space for identity formation (Eccles and Roeser, 2011).

Self-Determination Theory provides a coherent interpretive framework for understanding engagement, centering on the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. The promotion of autonomy through meaningful choices, the cultivation of competence through appropriately calibrated challenges, and the fostering of relationships characterized by acceptance and belonging constitute prerequisites for the development of intrinsic motivation and meaningful engagement (Niemiec and Ryan, 2009; Ryan and Deci, 2017).

Teaching practices are of crucial importance in creating emotionally safe learning environments. The adoption of supportive and student-centered approaches, the provision of structured yet flexible guidance, and the encouragement of active participation collectively strengthen intrinsic motivation and reduce disengagement (Wentzel and Miele, 2016). Such pedagogical contexts promote the development of trusting relationships and a positive school climate, which serves as a key catalyst for cognitive and emotional investment in learning.

While these theoretical perspectives converge on the multidimensional nature of engagement, they diverge in their interpretive emphasis. Self-Determination Theory foregrounds basic psychological needs and intrinsic motivation (Ryan and Deci, 2017), whereas engagement models emphasize the structural complexity of engagement as a construct manifested across behavioral, emotional, and cognitive levels (Fredricks et al., 2019). Ecological approaches, by contrast, highlight the role of school climate and relational dynamics as decisive contextual factors (Wang andDegol, 2016). The convergence of these perspectives underscores the necessity of a holistic understanding that transcends one-dimensional interpretations to encompass both individual and environmental determinants.

3. Psycho pedagogical Dimensions of School Life

The educator's role emerges as central to the formation of a supportive relational network within which trust, acceptance, and mutual respect are cultivated. A pedagogical environment that promotes autonomy while avoiding excessive prescriptiveness contributes significantly to students' engagement and the maintenance of active participation (Wang andDegol, 2016). The quality of teacher–student interaction is associated with increased levels of motivation and a positive orientation toward knowledge acquisition (SkaalvikandSkaalvik, 2018). Such a pedagogical environment is embedded within the broader school climate, which substantially influences the learning experience by strengthening the sense of belonging and the quality of interpersonal relationships (Simos andKatsinis, 2026; Simos et al., 2026c; Drigas et al., 2023).

The school experience is frequently accompanied by emotional challenges, including anxiety, fear of failure, and gradual disengagement from the educational process. These factors may act as barriers to active participation, particularly in the absence of safe spaces for expression and support. Strengthening social-emotional competencies and systematically developing tools for emotional regulation are critical components for preventing such phenomena (Durlak et al., 2011; Zins et al., 2004).

Behavior management assumes particular importance in this context, with emphasis on preventive approaches grounded in self-regulation and the understanding of underlying needs. Moving away from punitive practices and adopting empathy-based strategies helps reduce tensions and prevent the escalation of intense reactions (Simos, 2025a). Managing such situations requires pedagogical flexibility and sensitivity, taking into account the uniqueness of each student's learning profile (Simos, 2026).

Particular pedagogical value is attributed to errors, which are conceptualized not as indicators of failure but as opportunities for feedback and cognitive restructuring. Their constructive utilization fosters resilience and supports the development of a growth-oriented understanding of competence, promoting sustained effort and the acceptance of challenge (Boaler, 2016; Dweck, 2006). The quality of feedback is equally important; when feedback is constructive, specific, and free from punitive elements, it drives progress and enhances internal motivation. Targeted and clear guidance contributes to improved performance and the maintenance of high levels of engagement while simultaneously strengthening students' self-confidence (Hattie, 2012; Hattie and Timperley, 2007)

4. Collaborative Practices and a Sense of Belonging

A positive classroom climate constitutes a critical determinant of educational quality and a fundamental dimension of school life. It describes a pedagogical environment characterized by trust, mutual respect, emotional safety, and the genuine acceptance of all students. This climate is reflected in both teacher–student relationships and peer dynamics, which together form the social fabric of the classroom. Research consistently demonstrates that school climate is directly associated with academic achievement, school engagement, and students' emotional well-being, confirming that supportive and democratic practices enhance learning effectiveness (OECD, 2019; Thapa et al., 2013). Similarly, environments that promote inclusion and respect for diversity have been identified as foundational for social cohesion and equity in education (UNESCO, 2023).

Collaborative learning serves as a key pillar in this regard, as it fosters interaction, the exchange of ideas, and the joint construction of knowledge, while simultaneously supporting the development of social and communication skills (Johnson and Johnson, 2009; Wentzel and Miele, 2016). Through structured forms of collaboration, a sense of belonging is cultivated, collective responsibility for the learning journey is strengthened, and students' active participation is promoted (Eccles and Roeser, 2011).

Differentiated instruction is an additional critical factor in addressing the heterogeneity of learning needs. Adapting content, methods, and the pace of instruction enables the meaningful participation of all students, prevents exclusion, and strengthens their sense of competence and self-efficacy (Tomlinson, 2014; UNESCO, 2017). Concurrently, student-centered approaches shift the focus from teaching to learning, encouraging initiative, self-directedness, and personal connection with the subject matter, thereby fostering deeper forms of understanding (Fredricks et al., 2019).

Of particular importance is the amplification of student voice through practices that allow for the expression of opinions, the assumption of roles, and participation in decision-making. Recognizing students' perspectives contributes to the creation of a space of acceptance and mutual respect, fostering psychological safety and trust (OECD, 2013; Mitra, 2004).

Active listening and the meaningful integration of students' experiences serve as key factors in promoting inclusion and equitable participation, while simultaneously strengthening students' sense of identity.

The development of empathy and self-regulation skills further contributes to the creation of positive relationships and the reduction of conflict (Durlak et al., 2011). The adoption of inclusive structures ensures equal access to education, recognizing every student as an active and valued member of the learning community. The implementation of flexible and collaborative practices requires continuous reflection and adaptation on the part of educators, accounting for the uniqueness of each student's learning profile (Simos, 2026). Such approaches contribute to a framework that supports holistic development and enriches the experiential relationship with knowledge.

5. The Role of ICT in Enhancing Learning Engagement and Inclusion

5.1. The Role of ICT in Contemporary Education

The integration of Information and Communication Technologies (ICT) has fundamentally transformed teaching and learning over recent decades, generating substantial possibilities for pedagogical improvement (Haleem et al., 2022; OECD, 2021; Selwyn, 2016). ICT fosters global collaboration by transcending geographical barriers (UNESCO, 2023), supports personalized and adaptive learning experiences through diverse modes of instruction (Bernacki et al., 2021), and promotes interactive, multimodal classrooms while expanding access to information (Tan et al., 2019). At the student level, ICT facilitates a shift toward student-centered, collaborative learning that prioritizes inclusivity and accommodates diverse learning needs (Eronen and Kärnä, 2018; UNESCO, 2023). Understanding how to implement these digital innovations effectively is therefore essential to realizing their transformative potential.

ICT has emerged as a key enabler in the creation of flexible learning environments that enhance active participation and expand opportunities for collaboration. Digital practices facilitate interaction, promote the collective construction of knowledge, and foster a sense of participatory inclusion in the educational experience (Fredricks et al., 2019). Their implementation supports differentiated instruction, enabling adaptation to individual learning needs and ensuring equitable access to knowledge (OECD, 2013; Simos et al., 2026e; Kefalis et al., 2026; UNESCO, 2017).ICT also serves as a bridge between general and special education, enhancing the participation of students with diverse learning profiles through multimodal forms of access and expression. This use aligns with the principles of Universal Design for Learning (UDL), which provides multiple means of representation, engagement, and expression to advance inclusion and learning equity (Chaidi et al., 2021; Drigasand Theodorou, 2016; Rose and Meyer, 2002; Simos, 2025b). Moreover, ICT promotes student autonomy and creative expression, encouraging initiative and an exploratory orientation toward knowledge (Ryan and Deci, 2017), while contributing to the creation of emotionally safe learning environments that foster trust and a sense of community (Simos, 2025b).

When deployed in conjunction with sound pedagogical approaches, ICT can positively shape the student–school relationship. Digital environments function not merely as instruments for transmitting knowledge but as frameworks for engaging students as active learners within interactive and multifunctional contexts. Collaboration and sustained engagement, as long-term pedagogical objectives, significantly strengthen the sense of belonging within diverse and challenging educational settings.

5.2. ICT, Inclusion, and Differentiated Instruction

The heterogeneity of the contemporary classroom, comprising students with varied learning profiles, abilities, and needs, presents a significant challenge for inclusive and participatory education. Traditional teaching models risk marginalizing students who remain passive and disengaged, whereas digitally mediated instruction transcends the limitations of conventional approaches by placing the student at the center of the learning process (Bond et al., 2020; OECD, 2019; Simos, 2025a).

The integration of ICT into secondary education creates diverse opportunities for interaction and collaboration. With careful planning and substantive pedagogical expertise on the part of the teacher, digital tools reinforce the cognitive, emotional, and behavioral dimensions of student engagement (Fredricks et al., 2004). These opportunities encompass multimodal presentation methods, activities of varying complexity, group projects, and online discussions, all of which encourage students to assume active roles through initiative, group participation, and contributions to shaping the learning process.

The cultivation of social skills and the affirmation of each member's personal worth strengthen a culture of equality while fulfilling a fundamental educational objective. Schools that systematically integrate ICT demonstrate higher levels

of student participation and engagement (OECD, 2019). Active participation is associated with improved learning outcomes and more positive attitudes toward the learning process. Collaborative practices are further enriched through synchronous and asynchronous forms of interaction, transforming learning engagement into a collective experience and the classroom into a space where the unique capacities of each member are highlighted.

5.3. ICT and Students' Emotional Well-Being

The psycho-pedagogical development of adolescents represents one of the most significant determinants of academic performance and overall well-being. Emotional security, as a central component of this development, is a prerequisite for effective participation. Research has established clear connections between students' emotional states, including anxiety, self-confidence, and relational quality, and the capacity of digital environments to support these dimensions (Durlak et al., 2011; Simos, 2025a; UNESCO, 2023; Wentzel, 2010).

In school settings, students frequently experience performance anxiety stemming from fear of criticism, social comparison, or personal failure. Digital environments can mitigate such anxiety by providing time for reflection, the ability to revise responses, and options for anonymous participation. These conditions render the learning environment safer, as participation can be modulated by the student and the threat of public exposure is substantially reduced (Drigas and Sideraki, 2021; Mitsea et al., 2022 and 2023; UNESCO, 2023).

Enhanced self-confidence frequently derives from participation in low-risk or gamified activities, the benefits of which may gradually transfer to face-to-face interactions. Recognition of personal worth and increased confidence can significantly improve overall academic performance, and the design of such interventions can be effectively supported by technological affordances (Durlak et al., 2011; UNESCO, 2023). ICT enables personalized support tailored to the needs and pace of each student, thereby enhancing learning autonomy (Simos, 2025a). Students learn to function and collaborate as a team within a system that respects individual characteristics, with technology serving as a supportive and facilitating factor.

ICT further supports emotional security by fostering positive relationships. The inclusion of all students is strengthened through pedagogically oriented technological practices (UNESCO, 2023), while enhanced communication between students and teachers contributes to building trusting relationships within a framework that, while appearing less rigid, remains structured and goal-oriented (Wentzel, 2010). In sum, the contribution of technology to students' emotional security is contingent upon pedagogical quality: deep knowledge, structured planning, and clear objectives create the conditions for students to act autonomously and derive satisfaction from the learning process.

5.4. ICT and the Sense of Belonging

Amplifying student voice is a central tenet of contemporary educational science. ICT offers students opportunities for self-expression through multiple forms of communication, transforming the student from a passive recipient into an active, critical participant in classroom dialogue. Digital participation broadens communicative possibilities and enhances dialogue, enabling students to exchange perspectives and develop reasoned arguments (Bond et al., 2020; Simos, 2025b). Collaborative creation activities, in which students assume active roles, further strengthen collaborative competencies. The development of meaningful dialogue cultivates critical thinking and enhances engagement, while continuous feedback fosters trust and promotes active involvement regardless of learner needs or subject matter.

Digital participation facilitates the creation of equitable dialogue in which all perspectives are represented. Unlike traditional classroom settings, where certain students may dominate, digital environments enable a more equitable distribution of participation, promoting collaboration and diversity of opinion. The transition from theory to collaborative practice through ICT strengthens group dynamics and the sense of belonging (OECD, 2019; Simos, 2025c). Asynchronous communication provides additional space and time for students whose learning profiles require differentiation, ensuring higher-quality dialogue. Behavior management grounded in collaborative experiences further promotes an inclusive culture (Simos, 2025c), transforming participation into a fully realized pedagogical practice that empowers student expression.

When integrated with pedagogical and psycho-pedagogical sensitivity, ICT substantially enhances the sense of belonging in secondary education. By increasing student engagement, fostering emotional security, and encouraging student expression, a student–school relationship is formed that is grounded in mutual recognition and collaboration. Digital environments promote a positive classroom climate in which students feel accepted, capable, and connected to their peers and teachers. The reduction of student anxiety, the strengthening of self-confidence, and the assurance of equitable digital participation contribute to the creation of a learning community that transcends physical and social barriers (UNESCO, 2023). The sense of belonging is positively correlated with students' academic performance and well-

being (OECD, 2019), and the role of technology in promoting inclusion is most effectively realized when placed at the service of pedagogical goals.

6. ICT in Secondary Education: Towards Inclusive and Participatory Learning Environments

6.1. Is tech-driven teaching the new standard?

The modern classroom has evolved into a dynamic, technology-rich environment in which ICT empowers both teachers and students (OECD, 2021). The utilization of ICT in this context extends beyond the presentation of digital material. Educational technology provides an array of digital tools and platforms that enable more engaging, flexible, and personalized learning experiences, transforming traditional instruction into interactive and inclusive processes (Crompton and Burke, 2023; Haleem et al., 2022).

Popular digital platforms and applications form the backbone of contemporary classrooms. Learning Management Systems (LMS) centralize assignments, grading, resource sharing, and communication, supporting seamless hybrid configurations (Snoussi, 2019), while interactive quiz tools add gamification and real-time formative assessment, enhancing participation and immediate feedback (Rajesh, 2025). Collaborative platforms facilitate real-time group work, visual brainstorming, and creative projects (Mohammed et al., 2019). With the emergence of artificial intelligence, AI-enhanced applications offer personalized feedback and automated content generation that can support learning in varied ways (Kilianová et al., 2024; Korda et al., 2024; Moraiti et al., 2022; PergantisandDrigas, 2024).

Beyond supporting learning directly, educators increasingly employ digital tools for the creation of instructional materials. Graphic design applications enable the creation of interactive presentations, infographics, timelines, and gamified lessons with embedded interactive features (ErfianaandRohmah, 2025). AI assistants streamline tasks such as drafting lesson plans, rubrics, and assessments, allowing educators to focus on instructional facilitation rather than material development (Syahrizal et al., 2024).

This digital integration supports the concurrent implementation of established educational methodologies while encouraging innovative forms of instruction, including blended, flipped, hybrid, and fully online models (Schmid et al., 2023). Blended learning has emerged as particularly effective across educational levels, combining face-to-face interaction with online components to enable personalized pacing and greater flexibility (Zou et al., 2025). Emerging trends such as AI-powered adaptive learning, VR/AR simulations, and gamified pathways further enhance student engagement, equity, and learning outcomes (Chimbo et al., 2026; Strielkowski et al., 2025). When thoughtfully integrated with existing pedagogies, these technologies reinforce and extend established practices (UNESCO, 2023). At the same time, careful, gradual digitalization that blends digital and non-digital approaches promotes inclusive instruction and helps bridge the digital divide among both students and teachers (Sophos, 2025).

6.2. Digitalization and digital transformation in the modern classroom

The developments outlined above signal an ongoing process of digitalization and digital transformation in contemporary schooling. The meaningful integration of ICT marks a pivotal shift in which digital technologies reconfigure pedagogical practices, interpersonal dynamics, and learning processes (Haleem et al., 2022). This evolution transcends supplementary tool use, moving toward systemic change that emphasizes innovation in instructional design and delivery (Hrastinski, 2021; Kuh, 2020; Selwyn, 2016; Tzagkourni et al., 2025).

Instruction has shifted from a predominantly transmissive model, centered on direct instruction and uniform content delivery, to a more interactive, constructivist, and adaptive approach that accommodates both direct and indirect learning practices (Schmid et al., 2023). Teaching increasingly incorporates multimodal resources, real-time data-driven adjustments, and collaborative activities that promote active knowledge construction and stimulate both cognition and metacognition (Philippe et al., 2020). The emphasis accordingly shifts toward fostering higher-order thinking, inquiry, and contextual application, enabling differentiated pathways that respond to individual learner profiles and paces. This transformation prioritizes dynamic engagement over static knowledge reproduction, aligning pedagogy with the demands of a knowledge-intensive society (Holmes et al., 2018).

The teacher's role evolves into that of a facilitator and pedagogical designer rather than the primary repository of information (UNESCO, 2023). Educators curate digital resources, scaffold learning experiences, and guide students in navigating complex information landscapes while cultivating critical digital competencies (Afriani et al., 2025). They monitor progress through analytical insights, provide targeted interventions, and attend to the socio-emotional dimensions of learning (Sreekanthaswamy et al., 2025). Although technology automates certain routine elements, the

teacher's irreplaceable contribution resides in relational guidance, motivational support, the ethical framing of technology use, and the assurance of equitable participation across diverse contexts (UNESCO, 2023, 2025).

The student's role correspondingly transitions toward greater agency and self-regulation, as learners become active co-constructors of knowledge who engage in self-directed exploration, collaborative inquiry, and reflective evaluation (Eronen and Kärnä, 2018; Santana Martel and Perez Garcias, 2022). Students assume responsibility for managing their learning trajectories, evaluating sources, and producing diverse outputs that demonstrate understanding (Ussenova et al., 2025). This shift cultivates autonomy, metacognition, and adaptability, preparing individuals for lifelong learning in fluid environments (Fazaand Lestari, 2025; Kim et al., 2025).

Central to these changes is digital learning, which encompasses technology-mediated processes that extend beyond physical boundaries to include blended, hybrid, and fully online modalities (Zou et al., 2025). Digital learning facilitates personalized, inclusive, and flexible experiences through adaptive systems, interactive platforms, and networked collaboration, enhancing accessibility while necessitating new literacies (Bernacki et al., 2021; Strielkowski et al., 2025). These interconnected shifts create more responsive, equitable, and future-oriented educational spaces, though balanced integration that preserves pedagogical depth while harnessing technological affordances remains essential (OECD, 2021; Sophos, 2025; UNESCO, 2023).

6.3. The Digital Paradigm: Opportunities and Obstacles in ICTs Integration

The digital transformation of the classroom brings significant advantages alongside notable challenges that must be addressed for equitable implementation (Haleem et al., 2022; Zou et al., 2025). ICT enhances accessibility, personalization, and engagement, while simultaneously introducing complexities related to infrastructure, equity, and human capacity (Arkoumanis et al., 2025; Sophos, 2025; UNESCO, 2023).

Among the principal advantages, ICT enables personalized and adaptive learning experiences, allowing instruction to be tailored to individual learner profiles, paces, and needs through data-driven tools and platforms (Bernacki et al., 2021; Haleem et al., 2022). ICT fosters interactive, collaborative, and multimodal environments that promote active knowledge construction, higher-order thinking, and real-world application (Tan et al., 2019; Zou et al., 2025). Emerging technologies further enhance motivation, flexibility, and inclusivity by supporting diverse learning modalities (Chimbo et al., 2026; Strielkowski et al., 2025). These innovations align education with the demands of a knowledge-intensive society, reinforcing the cultivation of essential digital competencies such as information evaluation, collaboration, and problem-solving (OECD, 2021; Simos andKarabatzaki, 2025; Simos et al., 2025).

However, the challenges are substantial and multifaceted. Technological barriers include inadequate infrastructure, unreliable connectivity, and the high costs of devices and maintenance, all of which exacerbate the digital divide and constrain access in underserved contexts (Sophos, 2025; UNESCO, 2023). Socioeconomic disparities mean that not all students benefit equally, potentially widening rather than reducing inequalities (Sophos, 2025; van Deursen and van Dijk, 2019). Pedagogical difficulties may arise when technology is implemented without sufficient alignment to learning objectives, leading to superficial use or distraction (Wang et al., 2022).

A particularly critical challenge concerns teacher preparation. Teachers' training and professional development are linked to student performance and academic success, while also supporting educator preparedness, job satisfaction, and retention (Tzagkourni et al., 2025). Many educators lack the confidence, digital skills, and pedagogical knowledge required to integrate technology effectively, resulting in underutilization or ineffective application (UNESCO, 2023; Zou et al., 2025). Without sustained professional development, teachers may struggle to progress beyond basic tool use to meaningful facilitation, instructional design, ethical oversight, and inclusive practice (Crompton and Burke, 2023). This underscores the necessity for systematic training programs that build technical proficiency, digital pedagogy, and awareness of equity issues. In sum, while ICT offers transformative potential through enhanced engagement and personalization, realizing these advantages requires overcoming technological barriers, addressing inequities, and prioritizing comprehensive teacher development to ensure that technology serves pedagogical goals rather than creating new divides.

7. Artificial Intelligence and Education

The integration of artificial intelligence (AI) into education constitutes one of the most significant developments in contemporary pedagogy, influencing both teaching practices and students' learning experiences (Holmes et al., 2022; Zawacki-Richter et al., 2019). Digital learning environments are now enhanced by intelligent systems that enable instruction to be tailored to students' individual needs, promoting personalization and active engagement (Dwivedi et

al., 2021; Tuomi, 2020; Zhai, 2022). Concurrently, AI creates new opportunities for inclusive education by providing tools that support students with diverse learning profiles and needs (UNESCO, 2021). Its implementation, however, requires thoughtful pedagogical planning and a critical disposition to ensure that technology functions as a complement to, rather than a substitute for, the educator's role.

An Ai application that is correlated with instruction is Educational chatbots. Educational chatbots are AI applications that enable direct interaction between students and digital systems, offering real-time support and guidance (Okonkwo and Ade-Ibijola, 2021). Through these systems, students can pose questions and receive immediate responses, which enhances interactivity and engagement. The use of chatbots contributes significantly to learning engagement by creating a dynamic environment in which the student assumes an active role (Huang et al., 2021; Pergantis et al., 2025; Politi-GeorgousiandDrigas, 2020). The continuous feedback they provide strengthens self-confidence and learning autonomy (Kasneci et al., 2023; Khalil and Er, 2023; Simos et al., 2026a; Simos et al., 2026b; Winkler andSöllner, 2018).Chatbots further facilitate personalized learning by adapting content and instructional pacing to each student's needs (Chen et al., 2020). This capacity is particularly valuable for students with varying levels of prior knowledge or specific learning difficulties. Additionally, chatbots can serve as instruments for enhancing collaborative learning by encouraging discussion and the exchange of ideas in group settings, thereby supporting the collective construction of knowledge (Krouska et al., 2022). Their use also promotes metacognitive development, as students are encouraged to reflect on their own learning processes (Graesser et al., 2018).

Artificial intelligence can also contribute significantly to the creation of inclusive learning environments by providing tools that adapt to the needs of all students (UNESCO, 2021). For students with learning difficulties, AI offers personalized solutions that enhance comprehension and engagement through adaptive learning systems that enable differentiated instruction (Guan et al., 2020; Holmes et al., 2022; Li and Wong, 2021; Mhlanga, 2023). The deployment of intelligent systems reduces barriers to participation, creating safe and supportive learning environments in which students feel more comfortable expressing themselves (Luckin et al., 2016). AI further enhances the development of social-emotional competencies by enabling interaction in low-stress environments (Tegos et al., 2023), which is particularly important for vulnerable student populations. However, its implementation demands vigilance to ensure equal access and the ethical use of data (UNESCO, 2021).

Despite its considerable advantages, the integration of AI into education is accompanied by challenges related to ethics, data protection, and pedagogical integrity (Holmes et al., 2022). The collection and use of personal data requires scrupulous attention to privacy and consent. There is a recognized risk of over-reliance on technology, which may negatively affect the development of critical thinking and autonomous reasoning (Ifenthalerand Yau, 2020; Roll and Wylie, 2020; Smutny andSchreiberova, 2020; Zawacki-Richter et al., 2019). The role of the educator remains essential in mediating the student–technology relationship. Unequal access to AI-powered technologies may also engender new forms of educational inequality, making the assurance of equal opportunities imperative (UNESCO, 2021).

The outlook for AI in education is, nevertheless, positive. AI has the potential to contribute to the modernization of instructional practices and the creation of more responsive and flexible learning environments (Luckin et al., 2016). The balanced, pedagogically grounded, and ethically informed deployment of artificial intelligence can substantially enhance the learning process while safeguarding the human dimensions of education that remain irreplaceable.

8. Conclusion

This study examined the interrelationship between school climate, students' sense of belonging, and learning engagement, foregrounding the roles of collaborative practices, ICT, and artificial intelligence as catalysts for inclusive and student-centered education. The analysis confirms that the creation of a positive and supportive school environment constitutes a foundational prerequisite for effective learning. The psycho-pedagogical dimensions of school life, encompassing teacher–student relationships, emotional safety, and behavior management, directly influence student participation and the formation of productive interpersonal dynamics.

Collaborative practices have been shown to be particularly effective in promoting active participation, social inclusion, and a robust sense of belonging. Group work and structured collaboration contribute to the development of communication skills, collective responsibility, and deeper forms of understanding. The integration of ICT expands opportunities for instructional differentiation, interactivity, and equitable participation, while digital tools support the creation of emotionally safe environments that accommodate diverse learner needs.

The emergence of artificial intelligence and chatbots represents a significant and dynamic prospect for the future of education. The personalization of learning, the provision of immediate feedback, and the capacity to adapt to individual

learner profiles are among the most notable advantages of these technologies. However, their effective deployment is contingent upon thoughtful pedagogical design, ethical safeguards, equitable access, and sustained teacher professional development.

Future research should prioritize longitudinal investigations of the sustained impact of ICT and AI on student belonging and engagement, particularly in diverse and underserved educational contexts. The development of evidence-based frameworks for integrating digital tools within inclusive pedagogies, coupled with systematic teacher preparation, will be essential to realizing the full potential of technology-enhanced education. Ultimately, the combined and balanced deployment of pedagogical practices and technological tools can contribute to the creation of learning environments that are inclusive, innovative, and genuinely responsive to the needs of all students.

Compliance with ethical standards

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The Authors proclaim no conflict of interest.

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