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Collaboration, Creativity and Compassion in a Digital Society

Designing compassionate conversational AI: A preliminary Self Determination Theory framework for digital wellbeing in higher education

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Conversational Agents (CAs) are rapidly transforming higher education by providing personalised learning support, adaptive feedback, and interactive educational experiences. However, most research has focused on learning performance rather than student's psychological wellbeing. This scoping review examines how Self Determination Theory (SDT) has been applied in the design of conversational AI to promote digital wellbeing and compassionate educational technology. Guided by the PRISMA Extension for Scoping Reviews (PRISMA-ScR), a systematic search of four major databases identified 28 eligible studies published between 2018 and 2026. Thematic analysis revealed that conversational AI predominantly supports student's competence through intelligent tutoring, adaptive scaffolding, and personalised feedback, while explicit support for autonomy and relatedness remains limited. Moreover, digital wellbeing is rarely considered an intended design outcome. Based on the synthesis, the review proposes a preliminary SDT-informed design framework comprising three need-supportive principles: supporting learner autonomy, strengthening competence, and fostering relatedness; alongside an overarching principle of promoting responsible AI use and digital wellbeing. Integrating motivational psychology with human-centred AI design, this review provides practical guidance for developing AI systems that support learner agency, psychological wellbeing, and sustainable engagement, contributing to the design of compassionate educational technologies for the future of higher education.

Keywords: Conversational AI, Self Determination Theory, digital wellbeing, compassionate technology, educational technology

Introduction

The rapid emergence of Generative Artificial Intelligence (GenAI) has fundamentally transformed higher education, enabling Conversational AI Agents (CAs) to become increasingly embedded within teaching, learning, and assessment (Adamopoulou et al., 2020). Unlike earlier educational technologies that primarily delivered static instructional content or adaptive tutoring, contemporary CAs powered by large language models (LLMs), such as ChatGPT, Claude, Gemini, and Microsoft Copilot, engage students in natural dialogue, provide personalised explanations, facilitate brainstorming, generate feedback, and support reflective learning (Kasneci et al., 2023; Tlili et al., 2023). As a result, conversational AI has evolved from a supplementary educational tool into an active learning companion that increasingly shapes students' cognitive, motivational, and emotional experiences. Recent work further illustrates this shift toward more personalised and context-aware CAs, including systems that integrate mobile and wearable sensor data to support health and wellbeing, and semantic conversational interfaces designed to facilitate behavioural change through personalised health information (Akhtar et al., 2026; Lee et al., 2026). Universities are rapidly integrating these systems into learning management systems, academic advising, digital libraries, and student support services because of their potential to personalise learning, democratise access to knowledge, reduce instructional workload, and improve learner engagement (Crompton & Burke, 2023; Zawacki-Richter et al., 2019). The growing integration of AI into education also highlights the importance of AI literacy, as learners and educators need the knowledge and critical capabilities to understand, evaluate, and engage appropriately with AI-enabled technologies (Su et al., 2023). Despite these opportunities, the widespread adoption of conversational AI has

raised important concerns regarding student psychological wellbeing and healthy engagement with digital technologies (Folstad et al., 2020). Recent studies highlight issues including excessive reliance on AI-generated responses, cognitive offloading, declining critical thinking, algorithmic bias, and reduced opportunities for meaningful human interaction (Dwivedi et al., 2023; UNESCO, 2023). Beyond supporting academic tasks, conversational AI increasingly influences how students regulate motivation, make decisions, evaluate their own competence, and engage with knowledge. These developments suggest that educational AI should not only optimise learning outcomes but also promote digital wellbeing, ethical engagement, and compassionate technology use (Miao & Holmes, 2023).

Digital wellbeing has consequently emerged as a key objective within educational technology research. Rather than focusing solely on limiting technology use, digital wellbeing refers to the extent to which digital technologies support psychological health, autonomy, meaningful engagement, social connectedness, and long-term human flourishing (Peters et al., 2018). Compassionate educational technologies similarly recognise students as whole individuals whose emotional, motivational, and relational needs are fundamental to meaningful learning rather than secondary considerations (Calvo & Peters, 2014). As conversational AI becomes an integral part of everyday learning, understanding how these systems can support rather than undermine learner wellbeing has become an important design challenge. Recent work on mobile and wearable sensor-fused CAs similarly demonstrates the potential of conversational interfaces to use contextual health data to provide more personalised support for wellbeing (Lee et al., 2026).

Self-Determination Theory (SDT) provides a strong theoretical foundation for addressing this challenge. Originally developed by Ryan and Deci (2020), SDT proposes that intrinsic motivation, wellbeing, and sustained engagement depend upon the satisfaction of three fundamental psychological needs: autonomy, competence, and relatedness. Autonomy refers to experiencing meaningful choice and volition; competence reflects feeling capable of mastering challenges; and relatedness concerns experiencing care, trust, and connection with others. Extensive evidence across education, psychology, healthcare, and human-computer interaction demonstrates that satisfying these needs enhances motivation, resilience, wellbeing, and lifelong learning (Ryan & Deci, 2017, 2020). The relevance of SDT to conversational AI is increasingly recognised because educational AI systems shape learner autonomy through personalised learning pathways and recommendations, competence through intelligent tutoring and adaptive feedback, and relatedness through empathetic dialogue and social presence (Ruan et al., 2019; Winkler & Sollner, 2018). Related work on semantic conversational interfaces for wearable health data also illustrates how conversational systems can translate personalised information into interactions intended to support behavioural change, suggesting opportunities for conversational AI to move from information provision toward sustained, user-centred support (Akhtar et al., 2026). However, these design features are often implemented independently without an explicit motivational framework, resulting in systems that prioritise task completion and academic performance over learner agency, emotional support, and long-term wellbeing. Although recent reviews have examined AI in higher education (Zawacki-Richter et al., 2019), educational chatbots (Winkler & Sollner, 2018), and GenAI for learning (Kasneci et al., 2023; Tlili et al., 2023), none have systematically synthesised how SDT informs the design of conversational AI for education. Existing reviews generally discuss motivation and engagement as secondary outcomes rather than examining how the psychological needs of autonomy, competence, and relatedness are operationalised within AI design. Likewise, digital wellbeing is rarely considered an explicit design objective, with most studies evaluating learning performance, usability, satisfaction, or technology acceptance instead. This represents an important theoretical and practical gap, particularly as human-centred AI approaches increasingly advocate designing intelligent systems that augment human capability, agency, and wellbeing rather than merely automating tasks (Shneiderman, 2022). Existing reviews primarily examine what conversational AI can do, whereas this review examines how conversational AI should be designed to support human psychological needs and digital wellbeing.

To address this gap, this study conducts a scoping review of the literature on conversational AI through the lens of SDT. Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR), the review systematically maps the existing evidence on how conversational AI systems support or constrain the psychological needs of autonomy, competence, and relatedness within educational contexts. Building on the findings of this synthesis, the paper proposes a preliminary SDT-informed design framework that translates motivational theory into practical design principles for developing more

compassionate conversational AI systems. Rather than conceptualising digital wellbeing as merely reducing technology use, the preliminary framework positions wellbeing as the outcome of AI systems that strengthen learner agency, scaffold meaningful competence, cultivate supportive interactions, and encourage sustainable engagement. By integrating motivational psychology with conversational AI design, this paper contributes a theoretically grounded perspective for developing educational technologies that support both effective learning and human flourishing. The study addresses the following research question: How has SDT been applied in the design of CAs for education, and what design principles emerge for promoting digital wellbeing and compassionate technology?

Methodology

This study employed a scoping review methodology to examine how SDT has been applied in the design of conversational AI for education and to identify design strategies that promote digital wellbeing. A scoping review was considered appropriate because the intersection of SDT, conversational AI, and educational technology is an emerging and interdisciplinary field characterised by diverse research designs, technologies, and theoretical perspectives. Unlike systematic reviews that primarily evaluate intervention effectiveness, scoping reviews are intended to map the breadth of evidence, identify research trends, and highlight knowledge gaps (Arksey & O'Malley, 2005; Peters et al., 2020). The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) to ensure methodological transparency and reproducibility (Tricco et al., 2018). A comprehensive literature search was conducted across four scholarly databases: Scopus, Web of Science Core Collection, ACM Digital Library, and IEEE Xplore. These databases were selected because they provide broad coverage of educational technology, human-computer interaction, artificial intelligence, computer science, and learning sciences. The search included peer-reviewed publications published between 2018 and March 2026, reflecting the rapid development of conversational AI following the emergence of transformer-based language models. Search terms combined concepts related to conversational AI (e.g., chatbot, AI tutor, virtual assistant, large language model, ChatGPT), SDT (e.g., autonomy, competence, relatedness, motivation), and educational contexts (e.g., higher education, learning, student). Reference lists of relevant reviews and included studies were also manually screened to identify additional publications (Figure 1. PRISMA-ScR flow diagram illustrating the study selection process for the scoping review: https://doi.org/10.6084/m9.figshare.33313284). The literature search identified 412 records from electronic databases and manual reference searching. Following duplicate removal, title and abstract screening, and full-text eligibility assessment, 28 studies met the inclusion criteria and were included in the final thematic synthesis. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

Studies were included if they (a) were published in English as peer-reviewed journal articles or conference papers, (b) investigated conversational AI or AI-enabled dialogue systems in educational settings, (c) explicitly applied SDT or examined one or more of its core psychological needs which are autonomy, competence, or relatedness, and (d) reported outcomes related to learner motivation, engagement, wellbeing, or educational experiences. Studies focusing exclusively on healthcare, commercial chatbots, non-educational conversational systems, technical algorithm development without educational application, editorials, dissertations, and other forms of grey literature were excluded. After duplicate removal, titles and abstracts were screened against the eligibility criteria, followed by full-text assessment. The selection process resulted in 28 studies that met the inclusion criteria and were included in the final synthesis. Data were extracted using a structured charting framework that captured publication year, country, educational context, conversational AI application, research methodology, participant characteristics, SDT constructs, educational outcomes, and implications for learner wellbeing. The inclusion criteria deliberately allowed studies that did not explicitly identify SDT as their theoretical framework when their reported findings addressed one or more constructs corresponding to the SDT psychological needs. This enabled the review to capture the broader body of evidence relevant to autonomy, competence, and relatedness while maintaining a clear distinction between explicit theoretical application and retrospective SDT-informed interpretation. Studies were therefore coded according to the constructs and evidence reported by the authors rather than being treated as explicit applications of SDT when SDT was not stated as their theoretical basis.

Due to the diversity of research designs, technologies, and outcome measures, a quantitative meta-analysis was not appropriate, therefore, a thematic synthesis was undertaken. Initial coding was guided deductively by the three psychological needs of SDT which are autonomy, competence, and relatedness (Ryan & Deci, 2020), while inductive coding identified emerging concepts including empathy, learner agency, AI dependency, ethical design, and digital wellbeing.

SDT was used as an analytical framework rather than as an inclusion criterion requiring studies to explicitly identify SDT as their theoretical foundation. This distinction was important because relatively few of the included studies explicitly stated that they were based on SDT. However, several studies examined phenomena that could be meaningfully interpreted in relation to the three SDT psychological needs of autonomy, competence, and relatedness. The analysis therefore proceeded in two stages. First, deductive coding was conducted using the three SDT psychological needs as the primary analytical categories. Evidence describing learner choice, control, goal setting, independent decision-making, or self-regulated learning was coded under autonomy. Evidence concerning feedback, scaffolding, adaptive support, perceived capability, mastery, or learning progress was coded under competence. Evidence involving empathy, social presence, trust, belonging, interpersonal connection, or supportive interaction was coded under relatedness. Importantly, a study was not classified as explicitly applying SDT solely because one of these features was present; rather, the coding captured the extent to which the reported findings could be interpreted through an SDT lens. Second, inductive coding was used to identify concepts that extended beyond the three psychological needs but were relevant to the review question. These included learner agency, AI dependency, empathy, transparency, ethical AI use, and digital wellbeing. The deductive and inductive codes were then compared across studies to identify recurring patterns, areas of convergence, and gaps in the evidence. This approach enabled the review to distinguish between (1) principles directly supported by reported features or outcomes in the reviewed literature, and (2) design implications developed by the authors by interpreting these findings through SDT. The resulting synthesis formed the basis for the preliminary design framework. Thus, the framework should be understood as an SDT-informed conceptual proposition derived from the evidence, rather than as a framework empirically validated by the reviewed studies. The evidence was synthesised into four overarching themes as supporting learner autonomy, enhancing competence through intelligent scaffolding, fostering relatedness through compassionate interaction, and designing for digital wellbeing. These themes informed the development of an SDT informed preliminary framework that translates motivational theory into practical design principles for creating learner centred, compassionate, and psychologically sustainable conversational AI for higher education.

Results

Although research on conversational AI in education has expanded rapidly, relatively few of the 28 included studies explicitly identified SDT as their theoretical framework. The majority examined constructs or design features that could be interpreted in relation to SDT, including learner autonomy, motivation, self-regulation, feedback, adaptive support, empathy, and engagement. The analysis therefore distinguishes between explicit SDT applications and SDT-informed interpretations of evidence from studies that did not explicitly invoke the theory. When the findings were mapped onto the three SDT psychological needs, competence emerged as the most extensively represented dimension, followed by autonomy, while relatedness received comparatively limited attention. This pattern reflects the design features and outcomes reported across the included studies rather than the explicit theoretical positioning of the studies themselves. The included studies were conducted predominantly in higher education and focused on AI tutors, educational chatbots, virtual teaching assistants, and LLM based CAs. Qualitative, mixed methods, and design-based research approaches were the most common, reflecting the exploratory nature of this emerging field. Thematic analysis showed that competence was the most frequently addressed psychological need.

Most conversational AI systems enhanced student confidence and perceived capability by providing immediate feedback, adaptive explanations, personalised recommendations, and step by step scaffolding (Kasneci et al., 2023; Okonkwo & Ade-Ibijola, 2021; Winkler & Sollner, 2018). Intelligent tutoring and formative feedback consistently improved learner engagement and academic performance. However, competence was generally measured using performance-oriented indicators such as task completion, grades, and user satisfaction rather than broader measures of self-efficacy or intrinsic motivation, suggesting limited alignment

with the holistic perspective of SDT (Ryan & Deci, 2020). Compared with competence, autonomy received considerably less attention. Several studies incorporated learner-controlled prompts, personalised goal setting, adaptive questioning, and optional hints that gave students greater control over their learning (Ruan et al., 2019; Tlili et al., 2023). Many conversational AI systems remained highly directive, frequently providing complete answers instead of encouraging reflection or independent problem solving. Such designs may contribute to cognitive offloading and excessive reliance on AI generated content, particularly following the widespread adoption of LLMs (Dwivedi et al., 2023; UNESCO, 2023). These findings suggest that future conversational AI should move beyond answer generation to support reflective learning, critical thinking, and learner agency. Relatedness emerged as the least developed SDT dimension. Although several studies incorporated encouraging language, empathetic dialogue, and anthropomorphic features to create rapport, few investigated whether these interactions genuinely strengthened student sense of belonging, trust, or social connection (Calvo & Peters, 2014; Kraut & Resnick, 2012; Liu & Sundar, 2018; Peters et al., 2018).

Empathy was typically implemented as a conversational feature rather than as a mechanism for supporting emotional wellbeing. Concerns regarding authenticity and excessive anthropomorphism indicate that conversational AI should complement rather than replace human relationships within educational settings by encouraging collaboration, reflection, and stronger connections between student's and educators. Across all three SDT dimensions, a consistent finding was the limited consideration of digital wellbeing as an explicit design outcome. Most studies evaluated conversational AI using measures such as usability, technology acceptance, learner satisfaction, or academic performance, while few examined psychological wellbeing, learner autonomy, healthy AI use as primary outcomes (Crompton & Burke, 2023; Kasneci et al., 2023; Venkatesh et al., 2003). This gap also reinforces the importance of AI literacy, as responsible engagement with AI requires learners to develop the capacity to critically understand its capabilities, limitations, and implications for their learning practices (Su et al., 2023). The synthesis indicates that conversational AI has significant potential to promote digital wellbeing when it simultaneously supports autonomy through meaningful learner choice, competence through adaptive scaffolding, and relatedness through compassionate interactions. These findings informed the development of the SDT informed conversational AI design principles presented in Table 1.

Table 1
Synthesis of SDT principles for designing compassionate conversational AI in higher education

SDT dimension	**How conversational AI currently supports the need**	**Evidence from the literature**	**Identified gap**	**Design implication**
Autonomy (Evidence Grounded Principle)	Personalised learning pathways, learner-controlled prompts, goal setting, adaptive questioning, and optional hints	Ruan et al. (2019); Tlili et al. (2023)	Many systems remain directive, providing complete answers that may reduce learner agency and encourage cognitive offloading	Design conversational AI that promotes reflection, inquiry, and informed choice before providing solutions, enabling students to develop self-regulated learning skills
Competence (Evidence Grounded Principle)	Intelligent tutoring, adaptive scaffolding, personalised feedback, and step-by-step guidance	Kasneci et al. (2023); Okonkwo & Ade-Ibijola (2021); Winkler & Sollner (2018)	Competence is primarily evaluated through academic performance, task completion, or user satisfaction rather than long-term confidence and intrinsic motivation	Provide feedback that develops mastery, self-efficacy, and progressive independence rather than simply improving task performance

Relatedness (Evidence Grounded Principle)	Empathetic dialogue, encouraging language, conversational rapport, and social presence	Calvo & Peters (2014); Peters et al. (2018)	Few studies demonstrate genuine social connectedness, and excessive anthropomorphism may create unrealistic expectations of AI	Use transparent, empathetic communication that complements human educators and encourages collaboration without replacing authentic human relationships
Digital Wellbeing (Author-proposed Design Principle)	Responsible AI guidance, ethical use recommendations, and learner support features	Crompton & Burke (2023); Kasneci et al. (2023); UNESCO (2023)	Digital wellbeing is rarely treated as an explicit design objective or evaluated using psychological wellbeing measures	Adopt a wellbeing by design approach by integrating autonomy, competence, and relatedness into AI design and evaluating wellbeing alongside learning outcomes

To synthesise the findings across the included studies, Table 2 summarises how conversational AI currently addresses each of the three psychological needs proposed by SDT alongside digital wellbeing as an emerging design objective. The synthesis highlights the dominant design strategies identified in the literature, the evidence supporting these approaches, the remaining gaps, and the resulting implications for future conversational AI design. Across the reviewed studies, competence was the most extensively supported psychological need, whereas autonomy and relatedness received comparatively less attention. Digital wellbeing was seldom treated as an explicit outcome, reinforcing the need for a wellbeing by design approach in future educational conversational AI.

Table 2
Thematic synthesis of the 28 included studies, illustrating how conversational AI supports the three Self-Determination Theory (SDT) psychological needs (autonomy, competence, and relatedness), the evidence identified in the literature, existing design gaps, and implications for designing compassionate conversational AI that promotes digital wellbeing in higher education

Design principle	Conversational AI feature	SDT need	Digital wellbeing outcome
Reflective prompting	Ask guiding questions before answering	Autonomy	Learner agency
Adaptive scaffolding	Progressive hints	Competence	Self-efficacy
Compassionate dialogue	Empathetic language with transparency	Relatedness	Psychological safety
Healthy AI use	Encourage independent work and reflection	All three	Sustainable AI engagement

Discussion

The synthesis reveals an important asymmetry in the current design of educational conversational AI. Systems are relatively well developed in supporting competence through feedback, scaffolding, and personalised assistance, but the evidence is considerably less developed regarding autonomy and relatedness. Importantly, this pattern should not be interpreted as evidence that conversational AI inherently satisfies competence while failing to satisfy the other needs. Rather, it reflects the aspects of learner experience that have been most frequently designed for and evaluated in the existing literature. The SDT-guided analysis also reveals a

distinction between functional support and psychological need satisfaction. For example, providing an immediate answer may improve task performance, but it does not necessarily strengthen autonomy if the learner has little opportunity to make decisions or engage in independent reasoning. Similarly, empathetic conversational language may create an impression of social support without necessarily producing the sense of belonging or connection represented by relatedness in SDT. These distinctions suggest that future research should move beyond evaluating whether conversational AI is useful or engaging and examine how particular interaction strategies influence psychological need satisfaction.

Based on the synthesis, this review proposes a preliminary SDT-informed conversational AI design framework (Figure 2. https://doi.org/10.6084/m9.figshare.33313308) comprising four interconnected design principles: (1) supporting learner autonomy through meaningful choice and reflective guidance; (2) strengthening competence through adaptive scaffolding and constructive feedback; (3) fostering relatedness through empathetic, transparent, and socially supportive interactions; and (4) promoting digital wellbeing by encouraging balanced AI use, learner agency, responsible self-regulation, and adherence to ethical principles for AI-supported education (Nguyen et al., 2023). Unlike existing frameworks that primarily emphasise system intelligence or learning efficiency, this preliminary framework positions psychological need satisfaction as the central mechanism through which conversational AI contributes to compassionate technology. Integrating these principles during the design process can help developers create AI systems that empower students rather than encouraging dependency, thereby aligning educational AI with broader goals of digital wellbeing and human flourishing.

This review has several limitations. The synthesis included only English-language, peer-reviewed publications and focused exclusively on educational applications of conversational AI, potentially excluding relevant insights from healthcare, workplace learning, or commercial AI systems. Because conversational AI and large language models continue to evolve rapidly, the evidence base remains relatively immature, with limited longitudinal research examining the long-term effects of AI on learner motivation, autonomy, and wellbeing. Future research should therefore move beyond evaluating learning performance to investigate how conversational AI influences psychological need satisfaction, ethical technology use, trust, resilience, and sustained digital wellbeing across diverse educational contexts. Longitudinal, cross-cultural, and design-based studies will be particularly valuable in validating and refining SDT informed approaches to compassionate conversational AI design. This review advances the notion of wellbeing by design; whereby psychological wellbeing is treated as a primary design objective rather than a secondary outcome of educational technology. Within this perspective, conversational AI is evaluated not only by its capacity to improve learning performance but also by how effectively it satisfies student needs for autonomy, competence, and relatedness. Designing for wellbeing shifts the focus from technological capability to human flourishing, offering a practical direction for future human-centred AI in education. The framework maps the three SDT psychological needs which are autonomy, competence, and relatedness to evidence grounded conversational AI design strategies and expected psychological outcomes, with digital wellbeing positioned as the overarching outcome. Responsible AI use and digital wellbeing are positioned as a cross-cutting, author proposed design consideration informed by gaps identified in the reviewed literature.

The framework was developed in two stages. First, the thematic synthesis identified three evidence-based design areas corresponding to the SDT psychological needs: supporting learner autonomy through meaningful choice and reflective guidance, strengthening competence through adaptive scaffolding and constructive feedback, and fostering relatedness through supportive and empathetic interaction. This direction is also consistent with emerging CA research that integrates contextual data and personalised interaction to support health, wellbeing, and behavioural change (Akhtar et al., 2026; Lee et al., 2026). Such systems illustrate how conversational AI can be positioned as an ongoing support mechanism rather than merely an information-delivery interface. These three areas represent patterns identified through the SDT-guided interpretation of the reviewed literature. Second, the authors translated these findings into broader design propositions for compassionate conversational AI. The synthesis highlighted the limited attention given to digital wellbeing, healthy AI use, learner dependency, and the appropriate role of AI in relation to human support. These observations informed a fourth, author-proposed principle concerning responsible AI use and digital wellbeing. Unlike autonomy, competence, and relatedness, digital wellbeing is therefore not presented as an additional SDT psychological need. Instead, it is conceptualised as an overarching design outcome that may be supported

when conversational AI is designed to satisfy the three psychological needs while encouraging responsible and sustainable engagement. The resulting framework should therefore be understood as a preliminary SDT-informed design framework. The first three principles are grounded in patterns identified across the reviewed evidence, whereas the fourth principle represents a design proposition derived from the identified gaps and interpreted implications of the synthesis. The framework is intended to provide a basis for future empirical testing and refinement rather than as an empirically validated model.

Design implications for educational conversational AI

The findings of this review suggest that conversational AI should be designed to support psychological wellbeing alongside learning performance. Rather than immediately providing complete answers, AI systems should encourage reflection, inquiry, and critical thinking to strengthen learner autonomy. Transparent explanations for recommendations and feedback can enhance student understanding and trust while supporting competence. CAs should also enable students to personalise the level and style of AI assistance according to their needs and learning goals. To foster relatedness, AI should employ empathetic, respectful, and supportive language without creating misleading impressions of human emotions or relationships. Conversational AI should promote balanced and responsible technology use through self-regulation prompts that encourage independent learning and healthy engagement. When conversations indicate emotional distress or wellbeing concerns, AI systems should facilitate timely referral to educators or professional support services rather than attempting to replace human care. These principles provide practical guidance for developing compassionate, human-centred conversational AI that promotes digital wellbeing in higher education. (See Figure 3. Implementation pathway for the SDT-informed conversational AI design framework (https://doi.org/10.6084/m9.figshare.33313314). The pathway translates the framework into an iterative design process by linking learner needs to SDT psychological needs, conversational AI strategies, intended psychological outcomes, responsible AI safeguards, and evaluation of learning and digital wellbeing outcomes. Evaluation findings are used to refine subsequent design decisions.

Conclusion

This scoping review examined how conversational AI in education can be understood through the lens of SDT. Although relatively few of the 28 included studies explicitly applied SDT, many reported design features and learner experiences that could be systematically interpreted in relation to autonomy, competence, and relatedness. The synthesis indicates that competence is currently the most extensively supported need, while autonomy and particularly relatedness remain less developed. The review also identified a broader gap in the treatment of digital wellbeing as an explicit design outcome. Building on these findings, the paper proposes a preliminary SDT-informed design framework comprising three need-supportive principles which are autonomy, competence, and relatedness, together with an overarching focus on responsible AI use and digital wellbeing. The first three principles are grounded in patterns identified across the reviewed literature, whereas the wellbeing dimension represents an author-proposed design direction derived from the gaps identified through the synthesis. The framework therefore provides a conceptual starting point rather than a validated model. Future research should empirically test whether these design strategies influence psychological need satisfaction, learner wellbeing, and patterns of AI use over time. Longitudinal, cross-cultural, and design-based research involving students and educators will be particularly important for validating and refining the framework. Such work can help establish whether conversational AI can move beyond improving task performance towards supporting learner agency, competence, meaningful connection, and sustainable digital wellbeing.

"The future of educational AI will be defined not by how intelligently machines respond, but by how effectively they help students become more autonomous, competent, and connected."

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