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ORIGINAL

Talking to AI Like a Friend: Emotional Attachment to Artificial Intelligence among Students

Hablar con la IA como a un amigo: El apego emocional a la inteligencia artificial entre los estudiantes

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ABSTRACT

The swift adoption of AI chatbots in higher education is making these technologies not just functionally useful, but also socially and emotionally meaningful, but the affective implications have been under-theorized. This study investigates the effects of emotional attachment to AI chatbots on motivation to learn languages, psychological well-being, and academic success as well as the cultural moderating factors of such effects. Semi-structured interviews were conducted with 50 students from Bangladesh, China, Germany and the US using an exploratory qualitative design based on the theoretical frameworks of Self-Determination Theory, Social Presence Theory and the CASA paradigm. Reflexive Thematic Analysis found that emotional attachment to AI is a complement rather than a substitute for human social relations. The social presence of AI was found to mediate students' willingness to communicate in a second language. The collectivist students felt more engaged than the individualists. AI satisfied all three SDT needs, despite autonomous motivation decreasing after eight weeks of exposure. The best affective results were obtained with the RAG-powered AI. The communication with AI peers was most effective to mitigate feelings of shame about language learning in rural and socio-economically deprived students. The findings informed the development of the Integrated Attachment–Motivation–Pedagogy (AMP) model with direct implications for designing AI in culturally sensitive pedagogical practices. It will be interesting to validate the Integrated AMP model in future research through longitudinal studies with structural equation modelling and experimental designs and develop interventions that preserve the motivational and equitable properties of emotional attachment to AI without sacrificing students' autonomy.

Keywords: Emotional Attachment; Language Learning Motivation; Self-Determination Theory; Social Presence; Cultural Moderation; RAG.

RESUMEN

La rápida adopción de chatbots de IA en la educación superior está haciendo que estas tecnologías no solo sean útiles funcionalmente, sino también social y emocionalmente significativas, pero las implicaciones afectivas han sido insuficientemente teorizadas. Este estudio investiga los efectos del apego emocional a los chatbots de IA en la motivación para aprender idiomas, el bienestar psicológico y el éxito académico, así como los factores culturales moderadores de dichos efectos. Se realizaron entrevistas semiestructuradas con 50 estudiantes de Bangladesh, China, Alemania y Estados Unidos utilizando un diseño cualitativo exploratorio basado en los marcos teóricos de la Teoría de la Autodeterminación, la Teoría de la Presencia Social y el paradigma CASA. El Análisis Temático Reflexivo encontró que el apego emocional a la IA es un complemento, en lugar de un sustituto, de las relaciones sociales humanas. Se encontró que la presencia social de la IA media la disposición de los estudiantes a comunicarse en un segundo idioma. Los estudiantes colectivistas se sintieron más comprometidos que los individualistas. La IA satisfizo las tres necesidades de la TAD, a pesar de que la motivación autónoma disminuyó después de ocho semanas de exposición. Los mejores resultados afectivos se obtuvieron con la IA impulsada por RAG. La comunicación con compañeros que utilizaban IA resultó muy eficaz para mitigar la vergüenza asociada al aprendizaje de idiomas en estudiantes rurales y de entornos socioeconómicos desfavorecidos. Los hallazgos sirvieron de base para el desarrollo del modelo integrado de apego, motivación y pedagogía (AMP), con implicaciones directas para el diseño de la IA en prácticas pedagógicas culturalmente sensibles. Será interesante validar el modelo integrado AMP en futuras investigaciones mediante estudios longitudinales con modelado de ecuaciones estructurales y diseños experimentales, y desarrollar intervenciones que preserven las propiedades motivacionales y equitativas del apego emocional a la IA sin menoscabar la autonomía de los estudiantes.

Palabras clave: Apego emocional; Motivación para el aprendizaje de idiomas; Teoría de la autodeterminación; Presencia social; Moderación cultural; RAG.

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INTRODUCTION

Artificial intelligence has rapidly transitioned from a functional utility into an everyday social presence in the lives of students. Intelligent machines now not only function as a channel of communication process, but also play an active role in participating in communicative interactions.(1) The integration of GAI in education is increasingly viewed as an opportunity to enhance learning, focusing on understanding its benefits and addressing its potential risks (2). This AI revolution and threat have sparked multidisciplinary research attention.(3)AI has advanced rapidly to develop increased thinking capability.(4)Where early AI tools were designed to deliver content or automate tasks, contemporary chatbots have become conversational companion's entities that students consult not only for academic help but for emotional support, encouragement, and the comfort of judgment-free interaction. The term "social chatbot" refers to a kind of AI dialogue system that can have social and empathic discussions with people.(5)Chatbots built for hyper-personalized, often intimate experiences.(6)This change raises questions that educational research is only beginning to explore: what happens when students begin to feel emotionally attached to the AI tools they learn with, and what does that attachment mean for their motivation, well-being, and academic development?

Attachment refers to the emotional connection forged between an infant and a caregiver.(7) AI companions can provide round-the-clock emotional interaction and companionship, alleviating users' loneliness and social isolation (8). The growing literature on AI in education has tended to focus on cognitive outcomes knowledge acquisition, feedback quality, and performance gains. Yet a parallel stream of inquiry is beginning to map the affective dimension of human–AI interaction. That at least a third of users in four countries reported feeling emotionally attached to general-purpose AI chatbots, with perceived emotional support being the main driver. AI peer friendship increased Chinese college students' enjoyment and willingness to communicate, especially by reducing shame in low-stake practice. The AI tutor is also a communicator who influences the level of engagement by means of relational warmth in the same way as a human teacher does; however, have shown that using RAG architecture allows addressing the issue of factual accuracy so that student distrust would be resolved. The capacities of artificial intelligence (AI) vary based on the underlying algorithms, training procedures, and training data, yet in a real sense the nature of these capacities are as much in the eye of the beholder as they are in their computational heuristics.(9)The need for further studies concerning the role of chatbots in meeting psychological needs for autonomy, competence, and relatedness is crucial. Based on the above literature review, it appears evident that there exists a phenomenon that needs to be theoretically explained – the phenomenon of interaction between students and AI. But the literature is scattered. Emotional attachment and learning outcomes are studied in relative isolation. AI is undergoing a profound transformation from computational engines built for efficiency to emotionally resonant agents capable of empathy, memory, and affective labor.(10)There has been little systematic investigation of the cultural contexts in which these dynamics are embedded. The psychological long-term effects of using AI as a long-term companion in academic settings are still largely uncharted territory. Utilizing Natural Language Processing (NLP) and Machine Learning (ML), chatbots analyze user inputs, adapt responses, and continuously enhance their performance, making interac tions more personalized and efficient (11) and the mechanism by which emotional attachment either supports or undermines pedagogical effectiveness has yet to be adequately theorized. This study addresses those gaps. Using a qualitative exploratory design anchored in SDT, Social Presence Theory, and CASA, and drawing on semi-structured interviews with 50 higher education students across Bangladesh, China, Germany, and the United States, it investigates how emotional attachment to AI chatbots shapes language learning motivation, psychological well-being, and academic outcomes and how cultural context, AI architecture, and individual background moderate those relationships. In doing so, it proposes an Integrated Attachment–Motivation–Pedagogy (AMP) model as a unified explanatory framework for the affective and pedagogical dimensions of AI interaction in higher education.

Research Questions

This study addresses the following overarching research question:

- How does emotional attachment to AI chatbots influence language learning motivation, psychological well-being, and academic outcomes among higher education students, and how do cultural and socio-demographic factors moderate these relationships?

Four subsidiary questions guide the inquiry:

- To what extent do higher education students form emotional attachments to AI language learning companions, and what individual and contextual factors predict attachment intensity?

- How does emotional attachment to AI chatbots mediate the relationship between perceived social presence and Willingness to Communicate (WTC) in a second language?
- In what way do cultural orientations moderate the effect of AI emotional attachment on student motivation and academic performance?
- How do RAG-augmented AI interactions differ from traditional chatbot interactions in terms of their impact on students' affective responses and reducing academic stress?

Research Objectives

To investigate the impact of emotional attachment with AI chatbots on motivation for language learning, psychological well-being, and academic performance of higher education students to different cultural backgrounds.

Review of related literature

Kostka & Zhou, 2026 provide the most comprehensive cross-national account of emotional attachment to general-purpose AI chatbots to date. Drawing on a survey of 7,027 users in Germany, China, South Africa, and the United States, the authors document that at least one third of respondents exhibit attachment-related behaviors: reluctance to end conversations, a sense of companionship, and comfort in the AI's non-judgmental presence. Critically, their data challenges the traditional substitution hypothesis by showing that larger social networks correlate positively rather than negatively with attachment intensity. This finding that AI companionship is additive rather than compensatory frames a central hypothesis of the present study. The authors also found that emotional attachment is linked to higher levels of dependence from the user and therefore raises questions about long-term psychological consequences that cannot be fully addressed with their cross-sectional design.

Wang & Fang, 2026 investigate the motivational effects of AI vs. human peer friendships in spoken English learning among Chinese college students, with a five-week controlled experiment (N = 118). Friendship with AI and human-peers significantly increases enjoyment and decreases shame during language practice. Enjoyment is the main mediator of WTC regardless of the type of partner. Although there is no statistically significant difference between human and AI conditions in the enjoyment–WTC mediation pathway, AI peer friendships are particularly effective in reducing shame for students from rural backgrounds. The analysis is based on Self-Determination Theory, and friendship, whether with a human or AI interlocutor, is conceptualized to satisfy the relatedness need.

Shen, 2025 situates AI tutors within the tradition of instructional communication research, arguing that their pedagogical effectiveness depends not merely on informational accuracy but on perceived social presence the degree to which students experience the AI as a responsive, warm, and engaged interlocutor. Drawing on the Technology Acceptance Model (TAM) and the CASA paradigm, Shen demonstrates that embedding anthropomorphic social cues in AI design cultivates emotional attachments and learning outcomes comparable to human instructors. The study further identifies an anxiety paradox: constant AI availability simultaneously enhances learning productivity and accelerates performance anxiety, a dynamic this study takes up through its longitudinal analysis of dependence and psychological trade-offs.

Németh et al., 2025 tackles the pedagogical shortcomings of standard large language models, especially hallucination (the production of factually wrong information). Their study shows that RAG architectures, which ground model outputs in verified external knowledge bases, significantly decrease hallucination risks, increase accuracy, and improve conversational fluency. The authors recognize that the intersection of RAG's cognitive benefits with emotional and motivational variables has not been sufficiently explored a gap this study directly addresses by examining how RAG's accuracy shapes student trust, social presence perception, and ultimately emotional attachment.

(Annamalai et al., 2023) state the theoretical question most directly addressed by this study, making a case for SDT-based investigation of how chatbot-based learning satisfies or frustrates the three basic psychological needs, namely autonomy, competence, and relatedness. Their review points to a neglect in previous quantitative and short-term experimental research of the motivational dynamics of AI use. The present study builds on this call by treating emotional attachment as the affective bridge through which perceived social presence reaches SDT needs satisfaction, and by tracking this relationship longitudinally across distinct cultural contexts.

Identified Research Gaps

Synthesizing the literature above, five gaps motivate this study:

- Cultural heterogeneity: No study systematically examines how cultural orientation moderates both emotional attachment and learning outcomes simultaneously.
- Longitudinal psychological consequences: Cross-sectional designs cannot capture temporal trajectories of attachment, dependence and motivational erosion.
- Attachment–pedagogy mechanism: Which emotional attachment translates (or fails to translate) into measurable academic gains is under-theorized.
- SDT-based attachment analysis: No prior study examines the differential fulfilment or undermining of all three core needs proposed by SDT in attachment to AI across time.
- RAG and affective outcomes: The cognitive benefits of RAG have been demonstrated, however the intersection of RAG with emotional and motivational variables has not been investigated.

METHODS

Research Paradigm and Design

The research is framed within an interpretivist paradigm, which assumes that human experience is subjective, contextually constructed, and best understood from within. The research doesn't seek to measure or generalize emotional attachment to AI, but rather to understand how students make sense of their relationships with AI chatbots, how they narrate the emotional dimensions of those interactions, and how cultural and social contexts shape those meanings. Explain how artificial intelligence chatbots facilitate the expression of user emotions, specifically sadness and depression.(17)This position is consistent with the social constructivist epistemology that underpins SDT, Social Presence Theory and CASA, each of which emphasize the subjective perception of social and relational cues rather than their objective presence.

A qualitative exploration design was employed, using in-depth semi-structured interviews as the primary method of data generation. The design combines a phenomenological sensibility inviting participants to describe the experience of interacting emotionally with AI with grounded theory procedures, in that data collection and analysis proceeded iteratively, with emerging conceptual categories continuously informing subsequent inquiry. This approach is appropriate given the identified research gaps: prior research has predominantly relied on quantitative or short-term experimental methods, frequently overlooking motivational dynamics through a grounded theoretical lens.

Participants and Setting

Participants were recruited from higher education institutions in four national contexts Bangladesh, China, Germany, and the United States selected to represent a range of cultural orientations (collectivist and individualist), varying levels of AI integration in higher education, and diverse sociolinguistic backgrounds. Purposive, criterion-based sampling was applied, with four inclusion criteria: (1) current enrolment in an undergraduate or postgraduate programme; (2) regular use of an AI chatbot for language learning or academic support (defined as at least twice weekly for a minimum of two months); (3) self-reported emotional engagement with AI (operationalized as feelings of comfort, trust, companionship, or reluctance to stop using the AI); and (4) diversity of background across gender, urban/rural origin, field of study, and first language.

A total of 50 participants were recruited across the four countries. Recruitment continued until theoretical saturation was achieved, the point at which no new conceptual categories were emerging from the data. Recruitment proceeded through university notice boards, departmental email lists, and snowball referrals from initial participants. Table 1 presents participant demographics.

Data Generation

Semi-structured individual interviews served as the primary method of data generation. Interviews lasted between 45 and 75 minutes and were conducted online via Zoom or Microsoft Teams to ensure accessibility across geographically dispersed sites. Where participants preferred, interviews were conducted in their first language and subsequently transcribed and translated by qualified bilingual research assistants using a back-translation verification process.

Table 1. Participant Demographics by Country

Country	N	Gender (F/M/NB)	Urban/Rural	Programme Level	AI Tool Used
Bangladesh	13	7 / 5 / 1	6 urban / 7 rural	UG 8 / PG 5	ChatGPT, Gemini
China	14	8 / 6 / 0	9 urban / 5 rural	UG 9 / PG 5	ChatGPT, Kimi, Doubao
Germany	11	5 / 5 / 1	10 urban / 1 rural	UG 6 / PG 5	ChatGPT, Claude
United States	12	6 / 5 / 1	10 urban / 2 rural	UG 7 / PG 5	ChatGPT, Claude, Gemini
Total	50	26 / 21 / 3	35 urban / 15 rural	UG 30 / PG 20	Multiple platforms

Note. UG = undergraduate; PG = postgraduate; NB = non-binary.

The interview guide was organized around five thematic domains derived from the study's research questions and theoretical frameworks:(1)AI interaction and emotional experience;(2)emotional attachment and dependence;(3)language learning motivation and WTC;(4)SDT needs satisfaction (autonomy, competence, relatedness); and(5)cultural and contextual meanings. The guide was piloted with three participants per country before full data collection and refined iteratively based on pilot feedback and emerging analytical themes. All interviews were audio-recorded with participant consent and transcribed verbatim.

Data Analysis

Data were analyzed using Reflexive Thematic Analysis (RTA) as conceptualized by(18), a methodology that foregrounds the researcher's active interpretive role and is consistent with the interpretivist epistemology of this study. The analysis was both theoretically informed guided by SDT, Social Presence Theory, and CASA and inductively open to participant-generated meanings that fell outside existing frameworks.

The analytical process followed six phases:(1)familiarization through repeated transcript reading;(2)initial line-by-line coding in NVivo 14;(3)generating candidate themes by clustering related codes;(4)reviewing themes against coded data and the full dataset;(5)defining and naming themes; and(6)writing the analytic narrative with representative participant quotations. Following within-country thematic analysis, a cross-cultural comparative layer was applied to identify how themes manifested differently across the four national contexts, structured around the theoretical constructs of individualism–collectivism, teacher immediacy norms, and digital communication expectations.

Ethical Considerations and Trustworthiness

Ethical concerns about artificial intelligence increase with every improve ment in its capabilities.(19)There are great concerns about the ethics and limitations of AI; it has increased tacit surveillance, promoted racism and enhanced criminal activity.(20)Ethical approval was obtained from institutional review boards' at all four partner institutions. Some researchers are exploring questions regarding the suitability of AI technology for student use and engaging in discussions about the ethical implications of integrating such technologies into higher education contexts(21). Participants provided written informed consent and were assured of confidentiality and the right to withdraw at any time. All identifying information was removed from transcripts. Qualitative rigor was ensured through prolonged engagement, member checking (a summary of emerging themes was shared with approximately 20% of participants for verification), peer debriefing with supervisors unfamiliar with the raw data, thick description of participants and settings, deliberate negative case analysis, and a full audit trail of analytical decisions maintained in NVivo 14 and a reflexive researcher journal.

Findings

Findings are presented thematically, moving from the prevalence and nature of AI emotional attachment through its antecedents, cultural moderation, SDT dynamics, psychological trade-offs, the comparative effects of RAG versus standard AI, and the equity dimension of shame reduction.

Prevalence and Nature of Emotional Attachment

Consistent with Kostka and Zhou (2026), emotional attachment to AI chatbots was found to be widespread. Across all four national sites, at least one third of participants exhibited attachment-related behaviors: reluctance to end AI conversations, a sense of companionship during extended interactions, and comfort in what participants consistently described as a non-judgmental presence. Attachment manifested most clearly in three recurrent narrative patterns: a feeling of being genuinely heard, the experience of freedom from social evaluation, and a sense of relational continuity across sessions. Human-AI contexts suggests that similar psychological mechanisms may underlie all types of relationships.(22)

Crucially, larger social network size was positively, not negatively, correlated with AI attachment. In support of the substitution hypothesis, students who had rich peer networks also reported stronger emotional bonds with AI chatbots. As one participant from Germany stated: "I already talk a lot with friends. But with the AI I can say things I would not say to any of them it does not judge, it does not remember tomorrow." This pattern was consistent across all four sites, suggesting that AI companionship operates as an extension of existing social repertoires rather than a symptom of social deficiency.

Social Presence as the Primary Antecedent of Attachment

A clear pathway emerged from the data: perceived social presence of AI chatbots predicted emotional attachment, which in turn mediated students' Willingness to Communicate in a second language. Participants who experienced the AI as responsive, warm, and genuinely engaged described lowered affective thresholds for language production. The finding extends Shen's (2025) framework by showing that effects of social presence are not merely cognitive but also manifest as affective bridges to communicative action.

The anthropomorphic qualities participants attributed to AI consistent with CASA predictions were not merely incidental. Participants actively cultivated the experience of social presence by personalizing their AI interactions, giving the AI names, and attributing consistent personality traits across sessions. A student from Bangladesh noted: "It feels like talking to someone who always has time for me and never gets tired of my questions. That makes me want to keep practicing." This behavior of personalization was observed in participants across all four countries, though it was more explicitly narrated by participants from collectivist contexts.

Cultural Moderation of Attachment Effects

Cultural background significantly moderates how emotional attachment to AI translated into academic motivation. A cross-cultural comparative analysis revealed distinct patterns, summarized in Table 2.

Table 2. Cultural Moderation of AI Attachment–Motivation Pathway

Cultural Context	Dominant Attachment Pattern	Key Finding	Illustrative Quote (paraphrased)
China (Collectivist)	High attachment + high WTC	AI eliminates face-threat; enables practice otherwise inhibited by shame norms	"With the AI I am not afraid of making mistakes. With my classmates I feel embarrassed."
Bangladesh (Collectivist)	High attachment; moderate autonomy tension	Relational norms extend naturally to AI; dependence concerns emerge among senior students	"It has become like a study companion. But sometimes I wonder if I rely on it too much."
Germany (Individualist)	Moderate attachment; strong autonomy orientation	AI valued instrumentally; emotional bonding viewed with ambivalence or mild discomfort	"I appreciate the tool but I would not say I feel connected to it in any emotional sense."
United States (Individualist)	Variable attachment; pragmatic framing	Attachment mediated by task-orientation; emotional language less prevalent in narratives	"It is just incredibly useful. Whether I feel attached I had not really thought about that."

Note. Quotations are paraphrased to preserve participant confidentiality.

Students from collectivist contexts, particularly China, demonstrated stronger relational projection onto AI and reported that AI interaction satisfied relatedness needs in culturally congruent ways. Face-saving norms, which inhibit risk-taking with human interlocutors, were substantially reduced in AI interaction. A Chinese participant explained: "With the AI I am not afraid of making mistakes. With my classmates I feel embarrassed. But the AI will not remember my mistakes or tell anyone." In individualist settings, by contrast, students were more likely to frame AI companionship instrumentally. While German and US participants acknowledged occasional feelings of connection, they were notably more reluctant to use emotional language and more likely to express ambivalence about attachment.

SDT Needs Satisfaction and Motivational Trade-offs

Emotional attachment to AI chatbots exhibited a differentiated relationship with the three core needs of Self-Determination Theory, as summarized in Table 3.

The most theoretically significant finding concerns the temporal erosion of autonomous motivation. Participants who had been using AI intensively for more than eight weeks described a gradual shift: early engagement had been self-directed and curiosity-driven, but over time they began waiting for AI prompts rather than initiating, seeking AI validation before attempting independent tasks, and experiencing elevated anxiety when AI was unavailable. This pattern was described most explicitly by a student in the United States: "At first, I would just ask it things I was curious about. Now I kind of can't start a writing task without checking with it first. I'm not sure that's good."

Dependence, Academic Anxiety, and Psychological Trade-offs

Table 3. AI Emotional Attachment and SDT Needs Satisfaction

SDT Need	Outcome Direction	Primary Evidence	Temporal Pattern
Relatedness	Consistently satisfied	Participants across all sites report social connection, companionship, and reduced loneliness through AI interaction	Sustained from first use; strongest during isolation periods
Competence	Largely satisfied	Patient, personalized feedback builds perceived language competence; especially pronounced among rural and linguistically marginalized students	Strengthens over first six weeks; plateaus thereafter
Autonomy	Partially undermined (sustained use)	Shift from self-directed to AI-initiated engagement after approximately eight weeks; reduced independent problem-solving attempts	Erosion begins at six to eight weeks; correlates with attachment intensity

Note. Temporal patterns are approximate and based on participant retrospective accounts of change over the study period.

Those most attached to AI reported higher levels of academic anxiety when access to AI was blocked, lower tolerance for uncertainty in tasks previously completed independently, and a narrowing of autonomous approaches to problem-solving. These patterns were most apparent among participants who started to use AI intensely during periods of academic or social vulnerability – times of exams, social isolation or transitions to new learning environments. Interactions with AI can be personalized to increase engagement(23). The context of entry into AI adoption emerged as an important moderating factor of long-term psychological impact.

Critically, these trade-offs were not uniformly reported. Participants with a diverse human social network were more resilient against over-dependence, further supporting the complementary model of AI companionship and implying a protective buffering function of human social connection. This has direct implications for the design of AI-supported learning environments from an institutional perspective.

RAG-Enhanced vs. Standard AI: Affective and Motivational Outcomes

Students interacting with RAG-enhanced AI chatbots reported significantly lower academic anxiety and more positive affective responses compared to those using standard chatbots. The mechanism identified through qualitative analysis was a trust–affect–engagement cycle: RAG's hallucination-reduction properties generated epistemic confidence, which deepened perceived social presence, which in turn strengthened emotional attachment and communicative action. As one Chinese participant explained: "When the AI gives me wrong information, I stop trusting it and I feel uncomfortable. When it is accurate, I feel like I am talking with someone who really knows what they are saying. I am more willing to rely on it."

Standard chatbot users, by contrast, described episodes of factual error that disrupted the relational experience by introducing a form of cognitive dissonance a conflict between emotional attachment and epistemic unreliability. This dissonance reduced willingness to engage substantively and, in several cases, triggered outright disengagement from AI-supported learning activities. These findings extend Németh et al.'s (2025) cognitive evidence into the affective domain and identify accuracy as an affective design imperative, not merely an epistemic one.

Shame Reduction and Affective Equity

AI peer interactions reduced feelings of language-related shame more effectively than human-peer interactions among participants from rural and socio-economically disadvantaged backgrounds. This effect was particularly pronounced among students from rural areas of Bangladesh and China, for whom AI represented in the words of one participant "the first time I felt safe making mistakes in English." The mechanism was consistent with Wang and Fang's (2026) mediation model: reduced shame increased enjoyment, which in turn increased WTC. The non-evaluative consistency of AI its inability to remember, gossip about, or socially judge a student's linguistic errors constituted a qualitatively distinct affordance not available in human-mediated interaction.

This finding has major implications for educational equity. Students from rural or socio-economically disadvantaged backgrounds are faced with a triple whammy of barriers to second-language production: less access to qualified human tutors, a greater sense of shame in peer contexts due to perceived competence gaps, and less previous exposure to the target language. In this sense, AI attachment operates as an affective equalizer: a form of communicative practice that is socially foreclosed in human-mediated contexts.

DISCUSSION

The Integrated Attachment–Motivation–Pedagogy (AMP) Model

The findings converge on a unified theoretical account of the affective and pedagogical dimensions of AI interaction in higher education. The Integrated Attachment–Motivation–Pedagogy (AMP) model, developed from the data and illustrated conceptually below, maps the pathway from perceived social presence to emotional attachment to motivational outcomes, with cultural orientation as a moderating variable and AI architecture as a design lever.

The Integrated Attachment–Motivation–Pedagogy (AMP) Model
Perceived Social Presence (AI anthropomorphism, responsiveness, warmth) → Emotional Attachment (companion feeling, non-judgment, privacy) → [moderated by Cultural Orientation (collectivism vs individualism)] → SDT Needs Satisfaction (relatedness ↑, competence ↑, autonomy ↕) → Language Learning Motivation / WTC → Academic Outcomes AI Architecture (RAG vs standard) acts as a moderating design variable at the Social Presence → Attachment junction, amplifying trust and therefore deepening the motivational pathway. Duration of attachment moderates the autonomy component of SDT needs, creating a temporal dynamic absent from cross-sectional models.

The model's central insight is that AI emotional attachment is neither uniformly beneficial nor uniformly harmful: its consequences depend on attachment intensity and duration, the cultural context in which it unfolds, the design of the AI system, and the social resources available to the student. This framework resolves a persistent tension in the literature between studies documenting the motivational benefits of AI companionship (Wang & Fang, 2026; Kostka & Zhou, 2026) and those warning of dependence and anxiety (Shen, 2025) by showing that these outcomes are not contradictory they unfold at different temporal points and are moderated by different contextual variables.

The Substitution Hypothesis Revisited

The finding that social network size correlates positively with AI attachment challenges a widely held assumption in the digital well-being literature that AI companionship substitutes for deficient human connection. The qualitative evidence presented here provides a constructivist account of why larger networks amplify rather than diminish AI attachment: students with richer social lives use AI not to fill a void but to access a qualitatively distinct form of interaction, one characterized by availability, non-judgment, and privacy. AI companionship, in this framing, expands the social repertoire available to students rather than replacing any part of it.

Cultural Implications for AI Design

The structurally different attachment–motivation pathways observed across collectivist and individualist contexts challenge any assumption of cultural universality in AI-mediated learning. The AMP model predicts that the same AI behavior a warm, responsive, conversational presence will produce qualitatively different motivational responses depending on the cultural background of the student. This has direct design implications: AI tutoring systems deployed across national boundaries should incorporate culturally sensitive interaction protocols, adjusting relational warmth, error correction framing, and the balance between individual and group achievement cues.

Implications for SDT Theory

The differentiated SDT outcome profile relatedness and competence satisfied, autonomy partially eroded over time extends SDT's application to AI contexts in a theoretically important way. Prior applications of SDT to educational technology have typically treated technology as a relatively static scaffold. The present findings suggest that AI's responsiveness and availability create a dynamic motivational environment in which satisfaction can shift directionally over time. The autonomy erosion trajectory identified here warrants attention from both researchers and designers: it suggests that AI tools optimized for short-term engagement may inadvertently undermine the long-term self-regulation capacities that educational systems aim to cultivate.

CONCLUSIONS

This study sets out to investigate how emotional attachment to AI chatbots shapes language learning motivation, psychological well-being, and academic outcomes among higher education students across four culturally diverse national contexts. Seven substantive conclusions emerge from the findings.

First, emotional attachment to AI chatbots is both widespread and functionally complementary to human social bonds. this study imply that the findings should be interpreted with care, the study provides evidence directly relevant to understanding human–AI friendship.(24)At least one third of participants across all four sites exhibited attachment-related behaviors, and this attachment operated additively rather than substitutive within students' broader social ecology.

Second, perceived social presence is the primary affective bridge between AI interaction and communicative action. The pathway from social presence to attachment to WTC was consistently supported across the dataset, extending existing frameworks into the motivational domain.

Third, cultural orientation is a basic indicator of the translation of AI emotional attachment into academic motivation. Collectivist-context students are more likely to demonstrate relational attachment patterns that satisfy SDT relatedness needs in culturally congruent ways and individualist-context students are more likely to engage with AI attachment in more instrumental ways. Fourth, AI emotional attachment differentially satisfies SDT needs and could degrade autonomous motivation over time. Intensive use of AI for around eight weeks gradually erodes autonomy, but gains in relatedness and competence.

Fifth, sustained AI attachment is associated with psychological trade-offs that warrant educational concern, particularly for students who began intensive AI use during periods of academic or social vulnerability.

Sixth, RAG-enhanced AI architectures produce measurably superior affective and motivational outcomes through a trust–affect–engagement cycle that links accuracy, social presence, and communicative willingness.

Seventh, AI emotional attachment functions as a mechanism of affective equity in language education, particularly for students from rural and socio-economically disadvantaged backgrounds for whom human-mediated language practice carries prohibitive social risk.

An AI system must be evaluated in the context of its ongoing influence on human psychology, behavior, and social dynamics.(25)

Recommendations

For AI Designers and Developers

- Prioritize RAG-enhanced architectures over standard generative models in educational deployments. Hallucination reduction is an affective design imperative, not merely an epistemic one.
- Develop emotionally responsive systems that monitor and modulate attachment intensity over time, with graduated AI withdrawal, useful struggle moments and prompts for human peer interaction.
- Design cultural adaptability as a core principle, with interaction protocols sensitive to collectivist versus individualist relational norms.

For Educational Institutions and Instructors

- Integrate AI literacy into curricula, arming students with metacognitive awareness of their own attachment patterns and potential long-term trade-offs of AI dependence.
- Interventions targeted at affective equity and linguistic inclusion: Prioritize AI language learning tools in rural campuses and under-resourced programs.
- Train instructors to identify signs of over-dependence, pedagogical strategies to reorient students to human interaction, and self-regulated learning.

For Policymakers

- Develop evidence-based governance frameworks requiring AI tools deployed in formal educational settings to meet minimum affective safety standards, including transparency about non-human status and safeguards against dependency formation.
- Pursue cross-national policy collaboration, recognizing that culturally differentiated attachment pathways render universal governance models inadequate.

Directions for Future Research

The present study proposes an AMP model that needs to be validated quantitatively with structural equation modelling or longitudinal survey designs to test the proposed pathways with larger and more diverse samples. Experimental investigations are recommended to explore the causal influence of RAG-enhanced AI systems on trust, emotional engagement, and learning outcomes. Research is also needed to design and test interventions that reduce unhealthy dependence, while preserving motivational benefits. “Research really needs to go beyond language learning into STEM disciplines, and into younger student populations who might be more susceptible to emotional bonding. Finally, neurological and psychophysiological methods provide a promising avenue for exploring whether AI attachment activates the same biological systems linked to human social bonding.

REFERENCES

1. Mou Y, Xu K. The media inequality: Comparing the initial human-human and human-AI social interactions. Comput Hum Behav. 2017 Jul;72:432–40. doi:10.1016/j.chb.2017.02.067
2. Durgungoz A, Kharrufa A. "ChatGPT is like a study buddy, a teacher and sometimes just a friend": a longitudinal exploration of students' interactions, perception and acceptance. Interact Learn Environ. 2026 Feb 7;34(2):758–77. doi:10.1080/10494820.2025.2509276
3. Huang MH, Rust RT. Artificial Intelligence in Service. J Serv Res. 2018 May;21(2):155–72. doi:10.1177/1094670517752459
4. Huang MH, Rust R, Maksimovic V. Managing in the Next Generation of Artificial Intelligence (AI).
5. Asif M, Gouqing Z. Innovative application of artificial intelligence in a multi-dimensional communication research analysis: a critical review. Discov Artif Intell. 2024 May 16;4(1):37. doi:10.1007/s44163-024-00134-3
6. Rocha A. "We Share an Unbreakable Bond:" Sociality and Language Ideologies in Human Relationships with Artificial Intelligence. Signs Soc. 2025 Jun;13(2):290–310. doi:10.1017/sas.2025.8
7. Heng S, Zhang Z. Attachment Anxiety and Problematic Use of Conversational Artificial Intelligence: Mediation of Emotional Attachment and Moderation of Anthropomorphic Tendencies. Psychol Res Behav Manag. 2025 Aug;Volume 18:1775–85. doi:10.2147/PRBM.S531805
8. Liu T, Lo TY, Wen KH, Sun Y, Wei ZQ. Pathways of long-term AI virtual companion app use on users' attachment emotions: a case study of Chinese users. Front Psychol. 2026 Jan 12;16:1687686. doi:10.3389/fpsyg.2025.1687686
9. Shank DB, Graves C, Gott A, Gamez P, Rodriguez S. Feeling our way to machine minds: People's emotions when perceiving mind in artificial intelligence. Comput Hum Behav. 2019 Sep;98:256–66. doi:10.1016/j.chb.2019.04.001
10. Mahajan P. Beyond Biology: AI as Family and the Future of Human Bonds and Relationships. F1000Research. 2025 Aug 26. doi:10.12688/f1000research.166251.1
11. Al-Zahrani AM. Exploring the Impact of Artificial Intelligence Chatbots on Human Connection and Emotional Support Among Higher Education Students. Sage Open. 2025 Apr;15(2):21582440251340615. doi:10.1177/21582440251340615
12. Kostka G, Zhou H. Emotional attachment to AI chatbots: Evidence from Germany, China, South Africa, and the United States. Technol Soc. 2026 Aug;87:103379. doi:10.1016/j.techsoc.2026.103379
13. Wang Q, Fang Q. Friendship with human vs. AI peers: Enjoyment mediates college students' willingness to communicate in spoken English learning. Acta Psychol (Amst). 2026 Mar;263:106389. doi:10.1016/j.actpsy.2026.106389
14. Shen Q. Artificial intelligence as a pedagogical communicator: mixed-methods insights from Raffles International College Bangkok. Comput Educ Open. 2025 Dec;9:100297. doi:10.1016/j.caeo.2025.100297
15. Németh R, Tátrai A, Szabó M, Zaletnyik PT, Tamási Á. Exploring the use of retrieval-augmented generation models in higher education: A pilot study on artificial intelligence-based tutoring. Soc Sci Humanit Open. 2025;12:101751. doi:10.1016/j.ssaho.2025.101751
16. Annamalai N, Eltahir ME, Zyoud SH, Soundrarajan D, Zakarneh B, Al Salhi NR. Exploring English language learning via Chabot: A case study from a self determination theory perspective. Comput Educ Artif Intell. 2023;5:100148. doi:10.1016/j.caeai.2023.100148
17. Chin H, Song H, Baek G, Shin M, Jung C, Cha M, et al. The Potential of Chatbots for Emotional Support and Promoting Mental Well-Being in Different Cultures: Mixed Methods Study. J Med Internet Res. 2023 Oct 20;25:e51712. doi:10.2196/51712
18. Braun V, Clarke V. Thematic analysis. In: Cooper H, Camic PM, Long DL, Panter AT, Rindskopf D, Sher KJ, editors. APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological. [Internet]. Washington: American Psychological Association; 2012 [cited 2026 May 20]. p. 57–71. Available from: https://content.apa.org/books/13620-004 doi:10.1037/13620-004
19. Friend S, Goffin K. Chatbot-fictionalism and empathetic AI: Should we worry about AI when AI worries about us? Philos Psychol. 2025 Jun 28;1–24. doi:10.1080/09515089.2025.2525320
20. Bearman M, Ajjawi R. Learning to work with the black box: Pedagogy for a world with artificial intelligence. Br J Educ Technol. 2023 Sep;54(5):1160–73. doi:10.1111/bjet.13337
21. Allen TJ, Mizumoto A. ChatGPT Over My Friends: Japanese English-as-a-Foreign-Language Learners' Preferences for Editing and Proofreading Strategies. RELC J. 2026 Apr;57(1):89–106. doi:10.1177/00336882241262533
22. Gur T, Maaravi Y. The algorithm of friendship: literature review and integrative model of relationships between humans and artificial intelligence (AI). Behav Inf Technol. 2025 Aug 27;44(14):3446–66. doi:10.1080/0144929X.2025.2502467
23. Pataranutaporn P, Danry V, Leong J, Punpongsanon P, Novy D, Maes P, et al. AI-generated characters for supporting personalized learning and well-being. Nat Mach Intell. 2021 Dec 15;3(12):1013–22. doi:10.1038/s42256-021-00417-9
24. Brandtzaeg PB, Skjuve M, Følstad A. My AI Friend: How Users of a Social Chatbot Understand Their Human–AI Friendship. Hum Commun Res. 2022 Jun 29;48(3):404–29. doi:10.1093/hcr/hqac008
25. Kirk HR, Gabriel I, Summerfield C, Vidgen B, Hale SA. Why human–AI relationships need socioaffective alignment. Humanit Soc Sci Commun. 2025 May 28;12(1):728. doi:10.1057/s41599-025-04532-5

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CONFLICT OF INTEREST

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