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Enhancing ESP Speaking Competence Through Simulation-Based Learning: A Systematic Review of Pedagogical Practices, Learning Outcomes, And Emerging Research Gaps

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Abstract: This systematic review examines the pedagogical and psychological foundations of developing English for Specific Purposes (ESP) speaking competence through simulation-based learning. Drawing on 30 empirical and theoretical studies spanning applied linguistics, educational technology, and professional education, the review synthesizes evidence on diverse simulation formats including virtual reality, role-play, game-based platforms, avatar-mediated environments, and AI conversational agents in reducing foreign language anxiety (FLA), enhancing motivation, and improving oral production. A four-stage pedagogical model (Activation → Cognitive-Communicative Training → Communicative Production → Reflection) is proposed, grounded in task-based language teaching, experiential learning, and situated cognition. While adopting a general ESP perspective, the review incorporates illustrative examples from professional domains such as architecture and engineering. The findings highlight the effectiveness of simulation-based approaches for developing speaking competence and identify emerging research gaps, particularly in relation to controlled experimental designs and long-term learning outcomes.

Keywords: ESP speaking competence; simulation-based learning; pedagogical practices; learning outcomes; research gaps; professional communication.

Introduction: The growing demand for English communication skills in professional contexts has significantly increased the importance of English for Specific Purposes (ESP) instruction. Developing speaking competence the ability to produce contextually appropriate oral discourse remains a central challenge in ESP across various professional domains. ESP instruction must address not only general oral fluency but also domain-specific discourse, technical vocabulary, and communicative practices of the Architecture, Engineering, and Construction (AEC) professions (Pilla et al., 2025). Speaking competence — the ability to produce contextualized oral discourse in professional settings presents particular pedagogical challenges: it demands real-time processing, integration of disciplinary and linguistic knowledge, and management of affective barriers such as foreign language anxiety (Shokirov, 2026a; MacIntyre & Gardner, 1994).

Simulation-based learning has emerged as a promising approach to these challenges. By creating task-focused environments that replicate professional communication scenarios client presentations, site inspections, design reviews, interdisciplinary coordination meetings simulations provide architecture students with authentic speaking practice unavailable in conventional classroom formats (Marković, 2016). Technological advances, including virtual reality (VR), AI conversational agents, game-based platforms, and avatar-mediated environments, have substantially expanded the range of simulation formats available to ESP educators.

Despite growing scholarly interest, the literature on simulation-based ESP remains fragmented across multiple disciplines. This review addresses that gap by examining 30 relevant studies to answer four research questions: (RQ1) What pedagogical approaches characterize effective simulation-based ESP speaking instruction? (RQ2) What psychological factors mediate speaking competence development in simulation environments? (RQ3) What sequential instructional model integrates best practices to optimize speaking development in architecture students? (RQ4) What are the practical implications for architecture educators? While this review adopts a general ESP perspective, particular attention is given to professional domains such as architecture and related technical fields, which serve as illustrative contexts for simulation-based speaking instruction.

METHODOLOGY

This review follows a systematic approach to literature selection, including database searches across Scopus, Web of Science, and Google Scholar. Predefined inclusion criteria encompassed: (a) ESP or professional English context, (b) explicit focus on speaking or oral production skills, (c) simulation-based pedagogical interventions (VR, role-play, game-based, avatar-mediated, or AI-agent formats), and (d) peer-reviewed empirical or theoretical studies. Non-peer-reviewed sources, studies focused exclusively on listening or reading, and studies without a discernible simulation component were excluded. A total of 30 studies published between 2010 and 2025 were selected for analysis and synthesis.

THEORETICAL FOUNDATIONS

1 ESP and Speaking Competence in Architecture

English for Specific Purposes adopts a learner-centered approach that tailors content, methods, and materials to specific professional domains (Pilla et al., 2025). In architecture, ESP speaking competence encompasses presenting design concepts, negotiating with clients, conducting site inspections in English, and participating in interdisciplinary coordination. These functions are characterized by specific lexical sets (structural systems, spatial terminology), genre conventions (design briefs, technical specifications), and pragmatic norms (turn-taking in professional meetings, hedging in client negotiations). Traditional decontextualized instruction cannot adequately address the dual demand for simultaneous mobilization of linguistic fluency and disciplinary expertise (Marković, 2016).

2 Simulation-Based Learning: Theoretical Basis

Simulation-based learning creates experiential environments in which learners engage with realistic scenarios, make decisions, receive feedback, and reflect on outcomes (Marković, 2016). Its theoretical foundations rest on three converging frameworks: (a) Experiential learning theory (Kolb, 1984) emphasizing the cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation; (b) Task-based language teaching (TBLT; Ellis, 2003), which positions meaningful, goal-directed communication as the primary driver of language acquisition; and (c) Situated learning theory (Lave & Wenger, 1991), which holds that knowledge and skill are most effectively developed within authentic communities of practice. The methodological framework for simulation-based ESP instruction in architecture education (Shokirov, 2026a) operationalizes these theories by embedding language practice within professional role structures specific to the AEC domain.

3 Architecture Education: Professional Communication Demands

Architecture programmes traditionally foreground visual communication and design thinking, often treating verbal skills as secondary (Piga et al., 2019). Yet professional practice is communicatively intensive. The integration of English communication development within disciplinary studio and technical courses — consistent with Content and Language Integrated Learning (CLIL; Coyle et al., 2010) — is therefore both pedagogically logical and professionally essential (Hunter et al., 2011; León et al., 2023).

PSYCHOLOGICAL FACTORS MEDIATING ESP SPEAKING DEVELOPMENT

1 Foreign Language Anxiety and Affective Barriers

Foreign Language Anxiety (FLA) encompasses communication apprehension, fear of negative evaluation, and test anxiety (MacIntyre & Gardner, 1994). FLA is among the strongest negative predictors of oral production in L2 contexts. Simulation-based environments address FLA through: (a) low-stakes practice that decouples performance from high-stakes

assessment; (b) avatar-mediated or game-framed interaction, which provides psychological distance and reduces face-threat (Wigham et al., 2013); and (c) gradual exposure to increasing communicative demands. Yang et al. (2022) demonstrated that an online simulation game reduced FLA across anxiety sub-groups, with the largest effects observed in moderate-to-high anxiety learners.

2 Motivation, Self-Efficacy, and Flow

Simulation-based ESP instruction enhances motivation through authentic professional relevance, challenge calibration, and feedback cycles. Marković (2016) found that over 92.6% of participants rated simulation as more useful and engaging than traditional instruction; Wang (2024) reported a 40% increase in learner engagement with virtual simulation. Self-efficacy the belief in one's capacity to accomplish a specific task directly predicts willingness to communicate (WTC) and actual speaking behavior (Bandura, 1997). Madjid (2025) reported a large effect size (Cohen's d = 1.29) across a six-session role-play programme, with self-reported confidence increasing significantly alongside speaking scores. Well-calibrated simulation design can also create flow states (Csikszentmihalyi, 1990) characterized by absorption, clear goals, and immediate feedback representing optimal conditions for speaking skill development (Marković, 2020).

SIMULATION FORMATS AND THEIR AFFORDANCES

The reviewed literature identifies six principal simulation formats. Table 1 provides a comparative overview.

Table 1

Comparative Analysis of Simulation Formats for ESP Speaking Development

Format	Example professional scenarios	Key benefits	Evidence
Virtual Reality (VR)	Virtual site inspection; client meeting in design studio	Motivation ↑; immersive engagement	Wang (2024): 35% speaking gain
Avatar / Synthetic Worlds	Multi-user design review in Second Life; ARCHI21 tasks	FLA ↓; comfort with L2 interlocutors	Wigham et al. (2013): confidence gains
Role-Play Simulations	Planning committee presentation; contractor coordination	Self-efficacy ↑; WTC ↑	Madjid (2025): d = 1.29; 22% gain
Game-Based Simulations	Vocabulary game with architectural lexis	FLA ↓ (high-anxiety learners)	Yang et al. (2022): significant outcomes
AI Conversational Agents	Practice with virtual building inspector or client	Perceived safety; no evaluative threat	Ericsson et al. (2023): pronunciation gains
Extended / Company Sims	Mock architectural firm project over multiple sessions	Flow states; autonomy; professional identity	Marković (2016): 92.6% positive ratings

Virtual Reality environments allow students to practice speaking in high-fidelity simulations of professional settings, with architecture-specific scenarios including walkthroughs with a virtual client, construction site safety briefings, and planning permission hearings (Akhmetova, 2024; Wen et al., 2023). Avatar-mediated synthetic worlds such as Second Life enable learners to interact through avatars, simultaneously developing

disciplinary competence and English speaking skills, as demonstrated by the ARCHI21 project (Hunter et al., 2011). Role-play and extended simulations including mock architectural firm projects spanning multiple sessions induce flow and develop both linguistic and professional competencies (Marković, 2016; Madjid, 2025). AI conversational agents provide a perceived-safe, non-evaluative interlocutor (Ericsson et al., 2023).

A FOUR-STAGE MODEL FOR SIMULATION-BASED ESP SPEAKING INSTRUCTION

Synthesizing the evidence reviewed, the following four-stage sequential model is proposed for ESP speaking instruction across professional contexts. It integrates task-based, experiential, and CLIL principles with attention to psychological factors. It represents a synthesis of existing literature, not an empirically tested intervention; controlled studies examining its effectiveness are a priority for future research.

Stage 1: Activation

Goal: Reduce affective barriers; activate disciplinary knowledge; build foundational lexis. Representative activities: pre-simulation briefings orienting students to the professional scenario; introduction of a technical vocabulary bank (load-bearing structure, setback requirements, thermal mass, glazing ratio); low-risk avatar-mediated tasks rehearsing formulaic expressions without face-to-face evaluation pressure (Wigham et al., 2013). Psychological rationale: Low-stakes entry reduces FLA (Yang et al., 2022); vocabulary pre-loading reduces cognitive overload during subsequent production (Fedorenko et al., 2020).

Stage 2: Cognitive-Communicative Training

Goal: Develop genre knowledge, discourse strategies, and professional speaking conventions. Representative activities: mini-simulations targeting professional discourse genres (hedging in client negotiations, turn-taking in coordination meetings, question-handling in design critique forums); analysis of authentic professional model communications; guided practice with focused feedback on discourse moves, register, and technical accuracy. Psychological rationale: Scaffolded success experiences build self-efficacy (Madjid, 2025); authentic professional frames increase intrinsic motivation (Marković, 2016).

Stage 3: Communicative Production

Goal: Develop fluent, autonomous speaking in complex, open-ended professional scenarios. Representative activities: virtual field trips (360-degree or VR) combined with conversational virtual humans simulating building inspectors or consultants (Wen et al., 2023); multi-participant design reviews with unpredictable client questions; extended mock-firm projects with staged communicative deliverables — project brief presentation → mid-design review → final presentation to committee (Akhmetova, 2024; Wang, 2024). Psychological rationale: Authentic complex tasks calibrated to competence level induce flow (Marković, 2020); professional role assumption builds WTC and professional identity.

Stage 4: Reflection and Consolidation

Goal: Develop metacognitive awareness; consolidate gains; identify targets for continued development. Representative activities: video review of simulation performances with structured self-assessment targeting pronunciation, discourse organization, technical accuracy, and pragmatic appropriateness; structured peer feedback using criterion-referenced rubrics; reflective learning journals; whole-group debriefing sessions. Psychological rationale: Metacognitive reflection enhances self-regulation and learner autonomy (Fedorenko et al., 2020; Ríos-Teillier et al., 2025).

EVIDENCE OF EFFECTIVENESS

Several studies provide quantitative evidence of speaking gains, though methodological limitations — small samples, absence of control groups, short intervention periods warrant caution. Madjid (2025) reported speaking test score improvements from 66.67 to 81.27 across six sessions of role-play simulation ($d = 1.29$ overall). Nurrahma et al. (2023) found average scores rising from 58.23 to 67.65 (approximately 16% improvement). Wang (2024) reported a 35% increase in speaking proficiency and 40% increase in engagement with virtual simulation relative to traditional methods, with an additional 25% enhancement from automated adaptive feedback.

Qualitative findings consistently report positive student perceptions. Marković (2016) found 92.6% of participants preferred simulation to traditional instruction, citing reduced speaking anxiety and increased professional relevance. Ericsson et al. (2023)

found students describing AI virtual human interaction as easy, fun, and safe, underscoring the anxiety-reducing potential of non-human interlocutors. Akhmetova (2024) reported increased motivation and deeper material engagement with VR-based instruction.

IMPLEMENTATION AND DISCUSSION

Effective implementation of simulation-based ESP instruction requires the selection of authentic professional scenarios, including client communication, workplace interaction, project presentations, and interdisciplinary collaboration. Technology selection should be driven by pedagogical goals and student characteristics. High-anxiety students benefit most from avatar-mediated or AI-agent interaction at initial stages; students with stronger speaking foundations benefit from high-fidelity VR or extended peer simulation (Hunter et al., 2011; León et al., 2023). Assessment should use criterion-referenced rubrics distinguishing linguistic accuracy and fluency, discourse organization, technical vocabulary, pragmatic appropriateness, and communication management strategies.

The reviewed literature frequently conflates speaking and listening within 'oral communication', and confounds ESP instruction, instructional approaches, and classroom methods. This ambiguity obscures research findings and practical recommendations. The present review maintains the terminological distinctions established in Section 1 and recommends that future researchers adopt similarly explicit conventions. Although multiple studies examine AEC-adjacent contexts, the majority of evidence derives from business, engineering, and general vocational ESP programmes. Architecture-specific speaking situations — with their particular combination of aesthetic, technical, and regulatory discourse — may not be fully captured by these adjacent domains.

LIMITATIONS AND CONCLUSION

The present review carries several limitations. As a systematic literature review, it synthesizes and proposes rather than generating new empirical data; the four-stage model is theoretically grounded but untested as an integrated programme. Reviewed studies exhibit methodological limitations including small samples, absence of control groups, reliance on self-report measures, and short intervention periods. Long-term retention, transfer to professional practice, and individual difference factors (prior proficiency, cultural context) remain under-examined. Architecture-specific evidence is sparse relative to adjacent professional domains. These limitations define the agenda for future research, which should prioritize controlled experimental studies in architecture education, longitudinal outcome tracking, and cross-cultural implementation.

This systematic review demonstrates that simulation-based approaches virtual reality, avatar-mediated environments, role-play, game-based learning, and AI conversational agents offer meaningful advantages over conventional classroom instruction for developing professional oral communication in English. The four-stage model (Activation → Cognitive-Communicative Training → Communicative Production → Reflection) provides a theoretically grounded framework attending simultaneously to pedagogical sequencing and the psychological factors FLA, motivation, self-efficacy, flow that mediate speaking development. Future research should prioritize comparative evaluation of simulation formats and architecture-specific empirical studies with rigorous experimental designs. Ultimately, simulation-based ESP speaking instruction represents a promising pathway to equipping architecture students with the oral communication competence required for professional practice in an increasingly globalized built environment sector.

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