

Conceptual Framework of an AI-Enhanced Mobile Learning Model Through the EDU Coach Application to Improve English Speaking Confidence and Communicative Competence of Pre-service Education Students

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Abstract

The rapid advancement of artificial intelligence (AI) and mobile learning technologies has created new opportunities for enhancing English language learning, particularly in developing communicative competence and speaking confidence among pre-service teachers. However, many existing AI-assisted language learning systems remain technologically oriented and lack integration with pedagogical, cognitive, and communicative learning theories. This study aimed to develop the Conceptual Framework of an AI-Enhanced Mobile Learning Model through the EDU Coach application to improve English speaking confidence and communicative competence among pre-service education students. The study employed a Research and Development (R&D) approach integrated with conceptual framework synthesis and prototype design methodology. The research was conducted in four phases: theoretical synthesis, conceptual framework development, EDU Coach prototype component design, and expert-based prototype evaluation. The conceptual framework was synthesized from six foundational bases: theoretical base, pedagogical base, communicative competence and English-speaking confidence base, media theory base, technology base, and contextual base. These foundations were operationalized into seven integrated prototype components: Mission-Based Learning Environment, Coach Selection Screen, Learning Zone, AI Coach with Real-Time Support, Feedback and Retry Loop, Progress Tracker, and Scaffolding Support Center. The prototype was evaluated by seven experts in English language teaching, educational technology, and teacher education. Quantitative data were analyzed using mean and standard deviation. The findings revealed that all evaluation dimensions exceeded the acceptance threshold ($M \geq 4.00$), with the overall prototype quality rated at a high level ($M = 4.55$, $SD = 0.38$). Perceived Overall Effectiveness received the highest expert-rating score ($M = 4.76$, $SD = 0.35$). The study concludes that expert appraisal indicates the EDU Coach prototype has strong theoretical coherence, pedagogical appropriateness, and practical feasibility for supporting AI-enhanced English communication learning in teacher education contexts.

Keywords: AI-enhanced mobile learning, communicative competence, English speaking confidence, pre-service teachers, artificial intelligence in education, mobile-assisted language learning (MALL)

1. Introduction

The rapid advancement of artificial intelligence (AI), mobile technology, and intelligent learning systems has substantially transformed contemporary educational environments, particularly in language learning contexts. AI-enhanced learning technologies have increasingly been integrated into educational practice to support personalized learning, adaptive feedback, autonomous engagement, and real-time interaction, all of which are considered essential competencies for learners in the digital era (Herrington & Oliver, 2000; Herrington et al., 2014). In English language education, mobile learning environments supported by AI technologies such as chatbots, natural language processing (NLP), and speech recognition systems provide new opportunities for learners to practice communication skills beyond traditional classroom boundaries. These technologies enable authentic, flexible, and context-aware learning experiences that support continuous language practice and individualized learning pathways (Qiao & Zhao, 2023).

Despite the growing availability of educational technologies, English speaking remains one of the most challenging

competencies for English as a Foreign Language (EFL) learners, particularly among pre-service teachers in Asian educational contexts. Many learners experience communication anxiety, low speaking confidence, fear of negative evaluation, and insufficient authentic opportunities for communicative interaction, which collectively reduce willingness to communicate in English (MacIntyre et al., 1998). In Thailand, English-speaking instruction has traditionally emphasized grammar-oriented and examination-driven pedagogies rather than authentic communication practice. Consequently, many pre-service teachers demonstrate limited communicative competence despite years of formal English education. These limitations become particularly problematic in teacher education contexts, where future educators are expected to communicate professionally, participate in global academic environments, and integrate English into educational practice.

The concept of communicative competence has therefore become central to contemporary language education. Canale (1987) conceptualized communicative competence as a multidimensional construct encompassing grammatical competence, sociolinguistic competence, discourse competence, and strategic competence. Contemporary digital learning environments additionally require learners to develop intercultural and digital communicative competence to communicate effectively within technology-mediated contexts. However, existing English language learning systems often focus primarily on linguistic accuracy while neglecting psychological dimensions such as speaking confidence, willingness to communicate, self-efficacy, and self-regulated learning capacity. Research has shown that anxiety reduction, self-efficacy development, and authentic communicative engagement are critical determinants of successful second-language speaking performance (Bandura, 1997; MacIntyre et al., 1998).

Recent developments in AI-enhanced learning technologies have created new possibilities for addressing these challenges. AI-supported conversational systems can provide adaptive scaffolding, immediate feedback, personalized learning support, and low-anxiety practice environments that encourage learners to engage in repeated speaking practice without fear of social judgment (Qiao & Zhao, 2023). Similarly, AI-powered recommendation systems and adaptive learning technologies have demonstrated substantial potential for personalizing learning pathways and improving learner engagement in higher education contexts (Huang et al., 2024). Nevertheless, many existing AI language learning applications remain technologically oriented rather than pedagogically grounded. They frequently emphasize isolated language drills, automated scoring, or vocabulary memorization without integrating broader theories of constructivism, self-regulated learning, authentic learning, communicative competence, and cognitive learning processes.

From a theoretical perspective, contemporary learning environments increasingly require multidimensional instructional designs integrating cognitive, constructivist, technological, and sociocultural learning principles. Constructivist theory emphasizes that meaningful knowledge is actively constructed through authentic engagement, reflection, and social interaction (Piaget, 1964; Vygotsky, 1978). Situated learning further argues that learning becomes more meaningful when knowledge is embedded within authentic contexts and real-world activities (Brown et al., 1989; McLellan, 1996). Cognitive theories such as Information Processing Theory and Cognitive Load Theory additionally emphasize the importance of instructional structures that support attention management, memory processing, and cognitive efficiency during learning (Klausmeier, 1985; Sweller, 1994). At the same time, self-regulation and self-efficacy theories highlight the importance of metacognitive monitoring, learner autonomy, motivational regulation, and mastery experiences in sustaining long-term learning engagement (Bandura, 1997; Flavell, 1979; Zimmerman, 2000a).

Although previous studies have explored mobile learning, AI-assisted language learning, and communicative language teaching independently, significant gaps remain in the integration of these domains into a unified conceptual framework specifically designed for pre-service teacher education. Existing studies rarely synthesize constructivist pedagogy, communicative competence theory, AI-enhanced adaptive learning, mobile learning affordances, self-regulation support, and English-speaking confidence development within a single coherent instructional model. Furthermore, limited research has operationalized these theoretical foundations into prototype-level learning systems specifically tailored to the contextual needs of Thai pre-service teachers. Many prior studies also focus predominantly on learning outcomes while providing insufficient explanation regarding the theoretical architecture and instructional logic underpinning AI-supported learning environments.

To address these gaps, this study proposes the Conceptual Framework of an AI-Enhanced Mobile Learning Model through the EDU Coach Application to Improve English Speaking Confidence and Communicative Competence of Pre-service Education Students. The proposed model integrates constructivist learning principles, communicative competence theory, cognitive learning theory, self-efficacy theory, self-regulated learning principles, media theory, and AI-supported mobile learning technologies into a unified framework for authentic English communication development. The EDU Coach application was designed as an AI-enhanced mobile learning prototype incorporating mission-based learning environments, adaptive AI coaching, scaffolding systems, progress analytics, and real-time communicative feedback to support learners' speaking confidence and communicative competence.

Accordingly, the objectives of this study were: (1) to synthesize the conceptual framework of the AI-enhanced mobile learning model based on multidisciplinary theoretical foundations, (2) to design and develop the EDU Coach prototype components grounded in the synthesized framework, and (3) to evaluate experts' perceptions of the prototype's quality, appropriateness, feasibility, and potential effectiveness through expert-based assessment. The findings contribute theoretically by extending the integration of AI-enhanced mobile learning with communicative competence development and practically by providing a prototype framework for AI-supported English communication learning in teacher education contexts.

2. Method

2.1 Research Design

This study employed a Research and Development (R&D) approach integrated with conceptual framework synthesis and prototype design methodology to develop the AI-Enhanced Mobile Learning Model through the EDU Coach application for improving English speaking confidence and communicative competence among pre-service education students. The study was conducted in four sequential phases: (1) synthesis of theoretical and pedagogical foundations, (2) conceptual framework development, (3) EDU Coach prototype component design and synthesis, and (4) expert-based prototype evaluation. The methodological structure was designed to ensure alignment between theoretical principles, pedagogical strategies, technological affordances, and prototype functionality.

2.2 Theoretical and Conceptual Framework Synthesis

The first phase involved synthesizing multidisciplinary theoretical foundations relevant to AI-enhanced mobile learning, communicative competence, English-speaking confidence, self-regulated learning, instructional design, and educational technology. The synthesis process drew upon six foundational bases: theoretical base, pedagogical base, English-speaking confidence and communicative competence base, media theory base, technology base, and contextual base.

Theoretical synthesis was conducted using a framework synthesis record form to identify the relationships between foundational theories and operational design implications for the EDU Coach application. Major theories synthesized included constructivist theory, cognitive theory, situated learning, SOI model, OLEs model, REALs model, communicative competence theory, self-efficacy theory, self-regulation theory, media theory, and authentic technology-based learning theory. The synthesized framework subsequently informed the design logic of the seven prototype components described in the Results section.

2.3 Prototype Component Design

The prototype design phase translated the conceptual framework into operational learning components for the EDU Coach application. Seven integrated prototype components were synthesized based on the relationships identified between theoretical principles and instructional requirements. These components included:

1. Mission-Based Learning Environment
2. Coach Selection Screen
3. Learning Zone
4. AI Coach with Real-Time Support
5. Feedback and Retry Loop
6. Progress Tracker
7. Scaffolding Support Center

The component design process employed a theory-to-design mapping procedure in which each component was explicitly aligned with its corresponding theoretical foundations, pedagogical principles, and technological affordances. A framework synthesis matrix was used to document the relationships among theoretical constructs, instructional strategies, system functions, and learning outcomes.

The prototype architecture emphasized mobile-first learning design, authentic communicative practice, adaptive AI-supported interaction, multimodal content delivery, scaffolding mechanisms, and self-regulated learning support. The EDU Coach prototype was designed as an AI-enhanced mobile learning environment integrating chatbot interaction, natural language processing (NLP), speech recognition technology, adaptive learning pathways, and progress analytics to support communicative competence development and speaking confidence enhancement among pre-service teachers.

2.4 Participants and Expert Evaluation

The prototype evaluation phase involved expert-based assessment of the EDU Coach prototype. A purposive sampling technique was employed to recruit experts with demonstrated experience in English language teaching, educational

technology, instructional design, teacher education, and AI-supported learning systems.

The study involved two expert groups across different development stages.

2.4.1 Framework and Prototype Design Experts

During the conceptual synthesis and prototype development phase, 15 multidisciplinary experts participated in evaluating the theoretical appropriateness, pedagogical alignment, and media quality of the proposed model. The panel consisted of:

- Five content experts responsible for verifying the accuracy and appropriateness of the English learning content,
- Five instructional design experts responsible for reviewing pedagogical structure and instructional strategies, and
- Five media and technology experts responsible for assessing multimedia design, usability, and media effectiveness.

The multidisciplinary evaluation process ensured that the learning innovation prototype was examined from multiple perspectives prior to implementation.

Table 1. Expert Groups Involved in Prototype Development

Participant Group	Number	Purpose
Content Experts	5	Verifying the learning innovation content
Instructional Design Experts	5	Reviewing the instructional design
Media Experts	5	Assessing media quality and effectiveness
Total Experts	15	Comprehensive prototype evaluation

2.4.2 Prototype Validation Experts

Following prototype synthesis, a second round of evaluation was conducted with seven independent experts who had not participated in the earlier framework verification stage. These experts specialize in English language teaching, educational technology, teacher education, and AI-enhanced learning environments.

The purpose of this phase was to evaluate experts' perceptions of the quality, feasibility, usability, and potential effectiveness of the EDU Coach prototype prior to learner implementation. The evaluation did not measure actual learning gains or behavioral outcomes.

1. Content Quality
2. Pedagogical Design
3. Technical Functionality
4. User Interface Design
5. Overall Effectiveness

2.5 Research Instruments

Three research instruments were employed in this study.

2.5.1 Framework Synthesis Record Form

The framework synthesis record form was used to synthesize relationships among theories, pedagogical principles, instructional strategies, technological functions, and prototype components. The form enabled systematic mapping between theoretical foundations and operational prototype design.

2.5.2 Prototype Evaluation Form

The prototype evaluation instrument consisted of a structured expert-rating questionnaire designed to assess the quality and appropriateness of the EDU Coach prototype. The instrument contained five evaluation dimensions, each comprising 10 items, measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The evaluation dimensions included:

- Content Quality,
- Pedagogical Design,
- Technical Functionality,
- User Interface Design, and

- Overall Effectiveness.

The acceptance criterion for prototype quality was established at a mean score of $M \geq 4.00$.

2.5.3 Prototype and Interface Artifacts

The EDU Coach mobile learning prototype, interface mockups, mission structures, AI coaching interactions, scaffolding modules, and progress-tracking interfaces served as design artifacts for expert review and validation.

2.6 Data Collection Procedures

Data collection was conducted in four stages.

Stage 1: Theoretical Synthesis

Relevant theories, models, and empirical studies related to AI-enhanced mobile learning, communicative competence, and English-speaking confidence were reviewed and synthesized.

Stage 2: Conceptual Framework Development

The conceptual framework was developed by integrating six foundational bases into a unified AI-enhanced mobile learning model.

Stage 3: Prototype Component Design

The EDU Coach prototype components were designed through theory-to-component synthesis and mapped using the framework synthesis matrix.

Stage 4: Expert Validation

The completed prototype was evaluated by experts using the prototype evaluation form. Experts independently reviewed the prototype components, mobile interface design, instructional flow, AI-supported functions, and pedagogical alignment before providing quantitative ratings and qualitative recommendations.

2.7 Data Analysis

Quantitative data obtained from expert evaluation were analyzed using descriptive statistics, including mean (M) and standard deviation (SD). The interpretation criteria for expert agreement were as follows:

Table 2. The interpretation criteria for expert agreement

Mean Range	Interpretation
4.51–5.00	Strongly Agree
3.51–4.50	Agree
2.51–3.50	Moderate
1.51–2.50	Disagree
1.00–1.50	Strongly Disagree

Consensus levels were additionally interpreted based on standard deviation values and distribution consistency across expert ratings.

Qualitative comments from experts were analyzed using thematic synthesis to identify strengths, limitations, and recommendations for prototype refinement prior to implementation.

2.8 Ethical Considerations

All experts participated voluntarily and were informed about the objectives and procedures of the study prior to participation. Expert responses were anonymized and used solely for research purposes. The study adhered to ethical principles related to informed consent, confidentiality, and responsible academic research practices.

3. Results

3.1 Conceptual Framework of the AI-Enhanced Mobile Learning Model

The conceptual framework of the AI-enhanced mobile learning model articulates the relationships among six foundational bases: the theoretical base, pedagogical base, English-speaking confidence and communicative competence base, media theory base, technology base, and contextual base. Each base informs specific design features and component functions of the model, as detailed below.

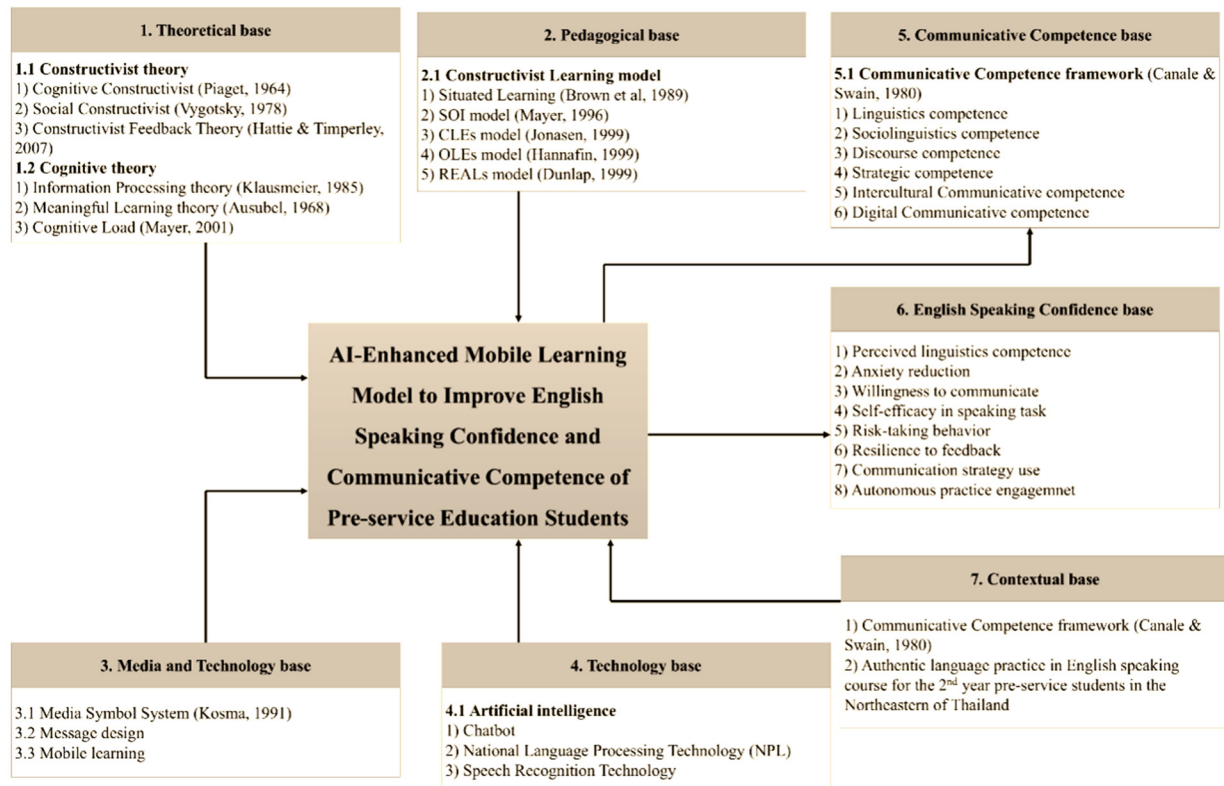


Figure 1. The Conceptual Framework of the AI-enhanced mobile learning model

3.1.1 Theoretical Base

In response to changes in how knowledge is constructed in the digital age, and to the documented need for innovative learning management approaches in pre-service teacher English-speaking development, the researcher drew on constructivist and cognitive theories as the foundational bases for the model's instructional design.

(1) Constructivist Theory. Constructivist theory strongly holds that learners can construct and refine their cognitive structures through active engagement with meaningful problems. Knowledge is created by establishing relationships between received information and the learner's prior knowledge. Two main constructivist traditions inform the AI-enhanced mobile learning model.

Cognitive Constructivism (Piaget, 1964). Piaget's cognitive constructivism posits that when a learner is stimulated by a problem that generates cognitive conflict or disequilibrium, they will inevitably attempt to adjust their cognitive structure to restore equilibrium. Assimilation refers to the incorporation of new information consistent with existing cognitive structures; accommodation refers to the restructuring of cognitive schemas when new information is incompatible with prior understanding. The knowledge created by each learner thus varies according to their a priori knowledge and original cognitive structure. Applied to this study, these principles inform the design of authentic speaking problem situations that stimulate learners to actively research, reason, and construct communicative knowledge rather than passively receive it.

Social Constructivism (Vygotsky, 1978). Vygotsky's social constructivism holds that learners' cognitive development is fundamentally shaped by their interactions with the social and cultural environments in which they are situated. Knowledge is co-constructed through dialogue and collaboration with more knowledgeable others including instructors, AI coaches, and peers. The Zone of Proximal Development (ZPD) is the key operative concept: it defines the space between what learners can accomplish independently and what they can accomplish with appropriate support. When

learners' current abilities fall below the ZPD for a given task, scaffolding assistance is required. This principle directly informs the model's Scaffolding Support Center, its three-level difficulty progression across missions, and the AI Coach's adaptive feedback mechanisms, all of which are designed to maintain learning within each learner's ZPD.

(2) Cognitive Theory. Cognitive theories explain learning as an internal process in the human brain, best understood by examining how information is processed, stored, and retrieved. Two cognitive theories provide the model's foundational design principles.

Information Processing Theory (Klausmeier, 1985). Information processing theory explains how humans acquire, store, recall, and retrieve knowledge through a process analogous to computer information processing. The process involves three memory stages. The sensory register is the initial, temporary repository of information received through all five senses; information is stored here only until it is processed, forgotten, or transferred to short-term memory. Short-term memory (working memory) is the second stage, with a strictly limited capacity of 7 ± 2 information units retained for approximately 15–30 seconds. Long-term memory receives information transferred from short-term memory through encoding; it is theoretically unlimited in capacity and duration, though practical forgetting does occur over time (Cowan, 2009; Shiffrin & Atkinson, 1969). Four areas are central to information processing theory: attention, learning strategy, knowledge base, and metacognition. These principles inform the model's content presentation design, including the use of bold text, highlighting, color, and chunked categorization to direct learner attention, support short-term memory encoding, and facilitate transfer to long-term memory for subsequent retrieval.

Cognitive Load Theory (Sweller, 1994). Cognitive load theory addresses the constraints imposed on learning by the limited capacity of working memory. Two categories of cognitive load are distinguished. Intrinsic Cognitive Load (ICL) is inherent to the complexity of the content itself and cannot be reduced. Extrinsic Cognitive Load (ECL) arises from the manner in which information is presented and can be reduced through deliberate instructional design. By reorganizing content presentation, grouping related information, and reducing unnecessary complexity in the interface, the ECL experienced by learners is minimized, thereby freeing working memory resources for productive cognitive engagement with learning. This principle directly informs the Learning Zone's advanced organizer design, the structured presentation of mission content, and the stepwise progressive disclosure of features in the Scaffolding Support Center.

Meaningful learning theory emphasizes that meaningful learning occurs when learners construct meaning through purposeful activity (Jonassen, 1997; Bruner, 1990). Five characteristics define meaningful learning (1) Active, requiring purposeful engagement; (2) Constructive, requiring reflection on activity and experience; (3) Intentional, requiring goal-directed effort; (4) Authentic, requiring contextually grounded tasks; and (5) Cooperative, requiring social collaboration and dialogue. Meaningful learning through technology is optimized when technology promotes knowledge construction rather than reproduction, conversation rather than passive reception, articulation rather than rote recitation, collaboration rather than competition, and reflection rather than prescription.

3.1.2 Pedagogical Base

The pedagogical base of the AI-enhanced mobile learning model is constituted by five complementary learning environment models, each contributing specific structural and functional principles to the model's design.

(1) Situated Learning (McLellan, 1996; Brown et al., 1989). The core principle of situated learning is that instruction focused on authentic experiences produces more meaningful and transferable learning than instruction focused on abstract knowledge transmission. Nine essential factors characterize effective situated learning environments: (1) authentic context, (2) authentic activity, (3) expert performances and modeling, (4) multiple perspectives, (5) collaboration, (6) reflection, (7) articulation, (8) coaching and scaffolding, and (9) authentic assessment. These principles are operationalized throughout the model: authentic professional teaching scenarios constitute the mission contexts; AI coach personas provide expert modeling; the Coach Selection Screen and Coaching Center provide personalized coaching; and the Progress Tracker and Feedback and Retry Loop provide authentic performance assessment.

(2) SOI Learning Model (Mayer, 1996). The Select-Organize-Integrate (SOI) model supports knowledge construction through three sequential cognitive processes: selecting relevant information from incoming stimuli, organizing selected information into coherent mental representations, and integrating new representations with prior knowledge. These three processes directly inform the Learning Zone's advance organizer design, which facilitates selection through emphasis techniques; the Cognitive Tool components, which support organizing functions; and the Adaptive Learning Path system, which supports integration by connecting new missions to previously mastered content.

(3) Open Learning Environments Model (Hannafin et al., 1999). Open Learning Environments (OLEs) emphasize the provision of tools, resources, and activities that extend and enhance learners' thinking, particularly for open or ill-structured problems where no single standardized answer exists. OLE values multiple perspectives and incorporates four foundational elements enabling contexts, resources, tools, and scaffolds all of which are directly instantiated in the model's

mission-based problem contexts, Learning Resource Center, Cognitive Tool components, and Scaffolding Support Center respectively.

(4) REALs Model (Dunlap, 1999). Rich Environments for Active Learning (REALs) encourage students to take responsibility, make autonomous decisions, and engage in meaningful learning within collaborative teacher-student environments. REALs embody constructivist values including collaboration, personal autonomy, generativity, reflexivity, active participation, personal relevance, and diversity. These principles inspire the model's collaborative mission design, optional challenge missions, peer practice features, and the gamified Progress Tracker, which foregrounds learner agency and intrinsic motivation.

(5) Constructivist Learning Environment Model (Jonassen, 1999). The CLE model is specifically oriented toward problem-solving and aims to develop learners' capacity to address complex, ill-structured challenges. Its core contribution to this model is the problem/project context design framework, which specifies that learners must be given: a rich contextual description of the problem situation (because the same problem appears differently across social contexts); an engaging and clear problem representation; and a manipulation space in which to test and receive feedback on their proposed solutions. The CLE also recommends providing learners with relevant examples, information resources, cognitive tools, dialogue and collaboration tools, and social contextual support all of which are instantiated across the model's seven components.

3.1.3 English Speaking Confidence, Communicative Competence, and Learner Self-Regulation Base

(1) English Speaking Confidence (MacIntyre et al., 1998). MacIntyre et al.'s situational model of L2 confidence conceptualizes speaking confidence as a multidimensional construct encompassing self-efficacy, anxiety, and willingness to communicate. The model identifies anxiety as the primary inhibitor of willingness to communicate in authentic contexts, and self-efficacy, the belief in one's capacity to perform successfully, as the primary positive motivational force. Eight dimensions of English-Speaking Confidence are operationalized in this model: Anxiety Reduction, Willingness to Communicate, Perceived Linguistic Competence, Self-Efficacy in Speaking Tasks, Risk-Taking Behavior, Resilience to Feedback, Communication Strategy Use, and Autonomous Practice Engagement. These eight dimensions constitute the measurement framework of the Progress Tracker and inform the affective design logic of each AI coach persona.

(2) Communicative Competence (Canale and Swain (1980)). Canale and Swain's framework defines communicative competence as comprising six interdependent domains: linguistic competence (grammatical, phonological, and lexical accuracy), sociolinguistic competence (register sensitivity and social appropriateness), discourse competence (coherence and cohesion in extended speech), strategic competence (communication strategies for managing difficulty or breakdown), intercultural communicative competence (cross-cultural sensitivity and adaptation), and digital communicative competence (effective communication through technology-mediated modes). All six domains are systematically addressed across the 30 missions of the Mission-Based Learning Environment and assessed through the Speaking Competence Rubric embedded in the Scaffolding Support Center.

(3) Self-Efficacy Theory (Bandura, 1997). Bandura's self-efficacy theory identifies four sources of self-efficacy beliefs: mastery experiences (direct performance successes), vicarious experiences (observing capable others succeed), social persuasion (verbal encouragement from credible sources), and physiological states (interpretation of affective and somatic cues). All four sources are addressed in the model: mastery experiences are built through the three-level difficulty progression; vicarious experiences are provided through AI coach modeling and expert prototypes; social persuasion is delivered through persona-calibrated encouragement; and physiological anxiety management is addressed through the anxiety reduction features and private practice environment.

(4) Learner Self-Regulation. Student self-regulation refers to the metacognitive processes through which learners plan, monitor, and evaluate their cognitive activities, thereby enhancing their capacity to learn effectively (Flavell, 1979; Zimmerman, 2000a). Student self-regulation operates through four sequential steps. Orientation involves three sub-processes: exploration of the task subject (goal orientation and task analysis at minimum for the general title, and additionally for subtitles and materials); more profound orientation (rereading, citing, or paraphrasing task instructions to ensure full comprehension); and structuring task instructions (underlining or schematizing requirements to indicate processing of task demands). Planning involves selecting an approach after considering various problem-solving alternatives. Monitoring encompasses two dimensions: monitoring of strategy use (structuring, highlighting, note-making, and schematizing to manage learning materials) and monitoring of progress (control and reflection on the problem-solving strategies applied and the proposed solution). Evaluation involves assessing the correctness, completeness, and effectiveness of proposed solutions. These four steps are operationalized in the Feedback and Retry Loop's four-phase progression model and in the Enhanced Self-Regulation features of the Progress Tracker.

3.1.4 Media Theory Base

All dimensions of the learning process are influenced by the cognitively relevant features of instructional media: their technology, symbolic systems, and information processing capacities (Kozma, 1991). Different media symbolic systems support different forms of knowledge construction: some learners rely on images to construct mental models; others construct adequate representations from verbal information alone; and many benefit from the simultaneous presentation of verbal and visual symbolic systems, which can substantially enhance encoding and comprehension. Each medium employs a distinct symbolic system to convey knowledge.

The AI-enhanced mobile learning model employs hypermedia as its primary symbolic system, enabling the simultaneous presentation of animation, graphics, text, audio, and hypertext links organized into interconnected knowledge nodes. Each node in the learning environment can be accessed from any location, supporting asynchronous, self-directed learning. The use of multiple media symbol systems expands learners' knowledge construction pathways, promotes collaborative interaction, facilitates the exchange of diverse perspectives on communicative challenges, and accommodates the full range of individual differences in learning modality preferences. Media theory thus underpins the multimodal design of every component within the model.

3.1.5 Technology-Based

The technological basis of the AI-enhanced mobile learning model is derived from research on authentic learning through technology (Herrington & Oliver, 2000; Herrington et al., 2014). Authentic technology-based learning builds a learning approach that integrates instructional content with web-based and mobile resources to promote effective, meaningful engagement. Five technology principles directly inform the model's design. First, the model provides learners with real problem situations that reflect the authentic professional contexts in which communicative knowledge is applied, specifically, the classroom, parent communication, and professional interaction scenarios encountered by pre-service teachers. Second, learners face real, open-ended communicative tasks in which they can construct knowledge through practice, experimentation, and dialogue. Third, the model provides asynchronous learning opportunities, enabling learners to engage with missions anywhere and at any time, consistent with the on-demand learning demands of mobile-first pre-service teacher populations. Fourth, hypertext and linked content nodes allow learners with insufficient prior knowledge to access additional resources on demand, thereby expanding their knowledge-construction pathways. Fifth, the mobile-optimized multimedia environment presents text, images, audio, and animation in forms consistent with learners' information processing capacities, supporting diverse modes of knowledge representation and retrieval.

3.1.6 Contextual Base

Designing a learning model requires systematic investigation of the context in which student learning is managed, to ensure that the design is consistent with and appropriate for the specific learner population. The contextual base of this model is the Faculty of Education, Northeastern University of Thailand, where pre-service teachers are enrolled in Bachelor of Education programs with English language teaching concentrations. The Thai English language teaching curriculum, the documented characteristics of Northeastern Thai EFL learners (characterized by limited authentic English exposure, high speaking anxiety, and moderate-to-low prior AI tool use), and the instructional constraints of the institutional context (including instructor experience levels, available infrastructure, and student technology familiarity) collectively constitute the contextual foundation that ensures the model's pedagogical relevance, cultural appropriateness, and practical feasibility.

3.2 *Designing the EDU Coach Prototype Components Based on the Conceptual Framework of the AI-Enhanced Mobile Learning Model*

The design of Prototype Components Based on the Conceptual Framework demonstrates the operational relationships between the theoretical principles synthesized above and the model's seven components. The synthesis tool used was the model designing framework synthesis record form.

Table 3. Designing Framework: Mapping Theoretical Bases to Model Components

Theoretical Base	Key Principle	Model Component	Design Application
Cognitive Constructivism (Piaget, 1964)	Cognitive conflict stimulates knowledge construction through disequilibrium and equilibration	Mission-Based Learning Environment	Authentic problem scenarios generate cognitive conflict requiring resolution through communicative practice
Social Constructivism (Vygotsky, 1978)	ZPD: scaffolded support enables learners to surpass current independent performance	Scaffolding Support Center; three-level B/I/A difficulty progression	Three levels of adjustable support calibrated to individual ZPD; adaptive difficulty prevents frustration or boredom
Information Processing Theory (Klausmeier, 1985)	STM limited to 7±2 units; encoding to LTM requires categorization and attention direction	Learning Zone; multimodal content design across all components	Chunked content, advance organizers, bold/color emphasis, and sequential disclosure manage cognitive load and support encoding
Cognitive Load Theory (Sweller, 1994)	Extrinsic cognitive load can be reduced through deliberate instructional design	Learning Zone; AI Coach interface design	Voice-first interaction, progressive disclosure, and intuitive navigation minimize ECL and free working memory for language production
Situated Learning (Brown et al., 1989; McLellan, 1996)	9 factors: authentic context, activity, expert modeling, collaboration, reflection, coaching, authentic assessment	Mission-Based Learning Environment; Coach Selection Screen; Coaching features	Profession-specific teaching scenarios; AI expert modeling through six coach personas; authentic performance rubrics
SOI Model (Mayer, 1996)	Selecting, Organizing, integrating information supports constructivist knowledge building	Learning Zone; Adaptive Learning Path	Advance organizers support selection; mission sequencing supports organization; adaptive paths support integration with prior learning
OLEs Model (Hannafin et al., 1999)	Enabling contexts, resources, tools, and scaffolds extend learner thinking	All seven components	Authentic mission contexts; structured resources; AI analytical tools; four-level adjustable scaffolding
REALs Model (Dunlap, 1999)	Collaboration, autonomy, generativity, and active participation in meaningful learning	Progress Tracker; optional challenge missions	Gamification, streak tracking, and optional missions build intrinsic motivation and autonomous engagement
CLE Model (Jonassen, 1999)	Problem context, representation, manipulation space, and feedback	Mission-Based Learning Environment; Feedback and Retry Loop	Rich scenario context with manipulation space for practice attempts; retry-loop provides feedback on performance
English Speaking Confidence (MacIntyre et al., 1998)	Anxiety reduction and self-efficacy building are prerequisites for willingness to communicate	Coach Selection Screen; Anxiety reduction features	Six AI personas address distinct psychological barriers; private practice modes normalize error-making
Communicative Competence (Canale & Swain, 1980)	Six domains: linguistic, sociolinguistic, discourse, strategic, intercultural, digital	30 missions across 5 content areas	Each mission targets one or more competence domains through profession-specific authentic scenarios
Self-Efficacy Theory (Bandura, 1997)	Four sources: mastery, vicarious experience, social persuasion, physiological states	Coach Selection Screen; Feedback and Retry Loop; Progress Tracker	Mastery through B/I/A progression; vicarious modeling via personas; encouragement through calibrated feedback; anxiety features address physiological cues
Student Self-Regulation (Flavell, 1979; Zimmerman, 2000)	Orientation, planning, monitoring, evaluation enable metacognitive learning oversight	Feedback and Retry Loop; Progress Tracker	Four-phase progression model develops self-regulation capacity; 8-dimension tracking enables metacognitive self-monitoring
Media Theory (Kozma, 1991)	Symbolic systems (visual, auditory, textual) shape knowledge construction processes	Learning Zone; multimodal design throughout	Hypermedia integrates animation, graphics, audio, text, and hyperlinks across all components
Technology Base (Herrington & Oliver, 2000)	Authentic mobile technology learning: real tasks, asynchronous access, multimedia, hypertext	System architecture; AI-powered components	Mobile-first design; offline capability; AI speech analysis; GPT-based conversation agents; cloud-based adaptive engine

3.3 Synthesized the EDU Coach Prototype Components Based on the Conceptual Framework of the AI-Enhanced Mobile Learning Model

The theoretical framework and designing framework synthesized above were used to derive the seven components of the AI-enhanced mobile learning model. Each component reflects a theoretically grounded design decision responding to both empirical evidence about learner needs and established principles from the theoretical bases described as detailed below.

Component 1: Mission-Based Learning Environment

The Mission-Based Learning Environment provides the primary instructional architecture of the model. Grounded in cognitive constructivism (Piaget, 1964), situated learning (Brown et al., 1989), and the CLE model (Jonassen, 1999), it presents learners with 30 authentic communicative tasks distributed across five professional content areas and mapped to six communicative competence domains. Three difficulty levels Beginner (B), Intermediate (I), and Advanced (A) operationalize the ZPD (Vygotsky, 1978), ensuring tasks are continuously calibrated to each learner's optimal challenge zone. The adaptive algorithm monitors multi-dimensional performance data and recommends level progression upon demonstration of consistent mastery (80% accuracy across three consecutive sessions), as illustrated in Figure 2.

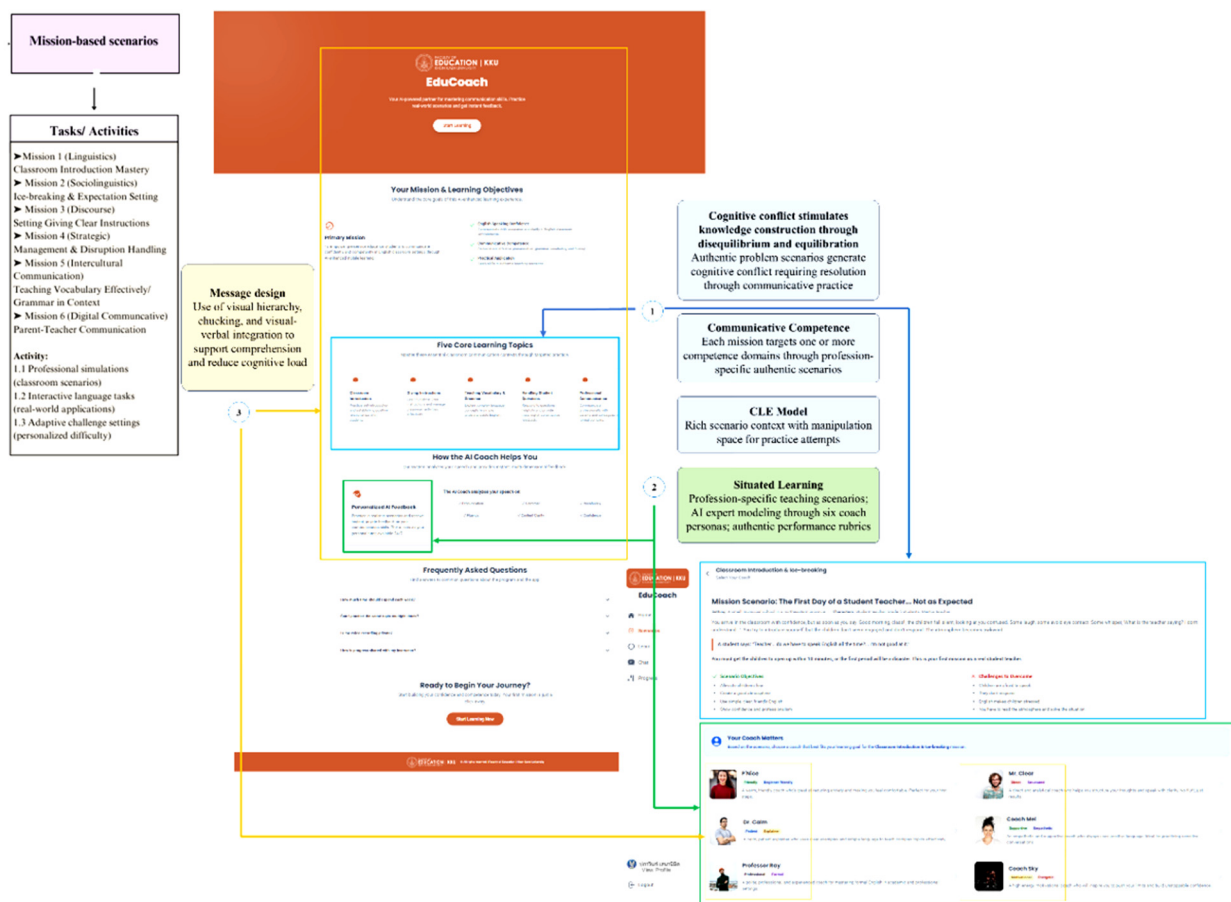


Figure 2. Activities of Mission-Based Learning Environment

Component 2: Coach Selection Screen

The Coach Selection Screen operationalizes self-efficacy theory (Bandura, 1997) and the MacIntyre et al. (1998) willingness to communicate framework by providing learners with deliberate choice of an AI coach persona aligned with their psychological profile. Six personas address distinct documented barriers: P' Nice (anxiety reduction), Mr. Clear (self-efficacy scaffolding), Dr. Calm (linguistic competence support), Coach Mei (empathetic feedback modeling), Professor Ray (sociolinguistic competence development), and Coach Sky (autonomous engagement stimulation). Granting learner agency in this choice constitutes the initial enactment of Bandura's social persuasion source of self-efficacy, as illustrated in Figure 3.

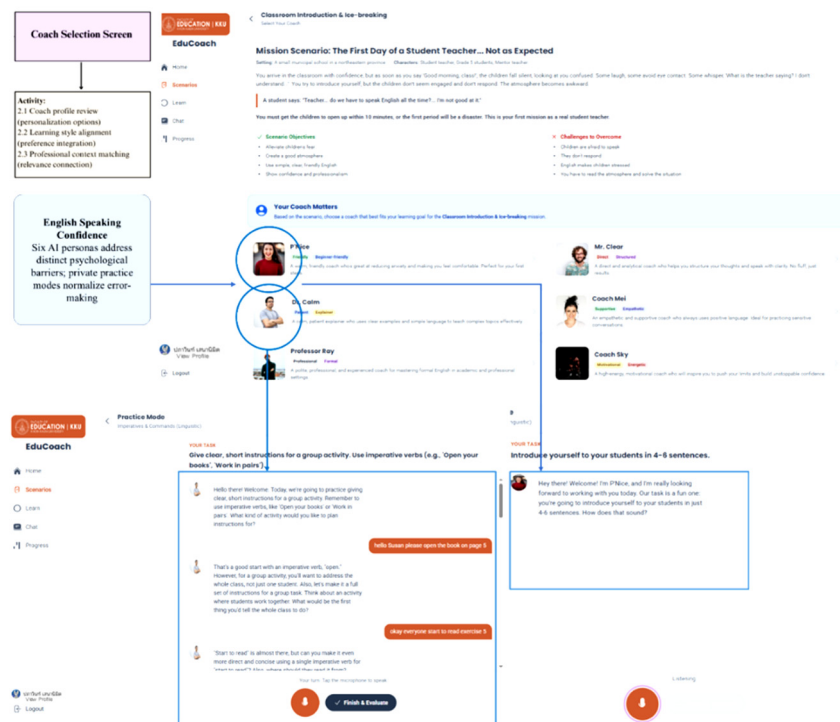


Figure 3. Activities of Coach Selection Screen

Component 3: Learning Zone

The Learning Zone implements cognitive load theory (Sweller, 1994), information processing theory (Klausmeier, 1985), the SOI model (Mayer, 1996), and media theory (Kozma, 1991) by providing mission previews, multimodal advance organizers, and structured contextual preparation that reduces extraneous cognitive load before speaking tasks begin. Visual emphasis techniques (bold, color, icons), sequential content disclosure, and voice-first interaction design support attention direction, short-term memory encoding, and long-term memory consolidation, consistent with information processing principles, as illustrated in Figure 4.

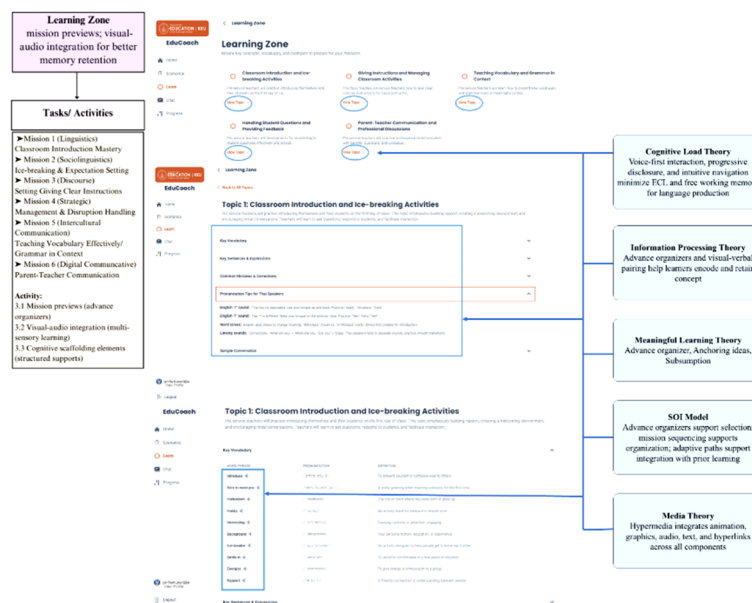


Figure 4. Activities of Learning Zone

Component 4: AI Coach with Real-Time Support

The AI Coach with Real-Time Support delivers scaffolded, persona-calibrated speaking assistance through seven integrated AI and natural language processing capabilities: intent recognition; multidimensional error detection in pronunciation, grammar, vocabulary, discourse, and pragmatics; persona-calibrated feedback generation; adaptive difficulty adjustment; pronunciation modeling; progress visualization; and personalized pathway generation. Because the present study evaluated a design prototype rather than a fully deployed system, these capabilities are specified as functional requirements to be verified through subsequent technical and learner-based testing. The component is designed to provide observable learning evidence through pronunciation feedback, weekly confidence tracking, competence rubrics, progress dashboards, and personalized recommendations (Qiao & Zhao, 2023), as illustrated in Figure 5.

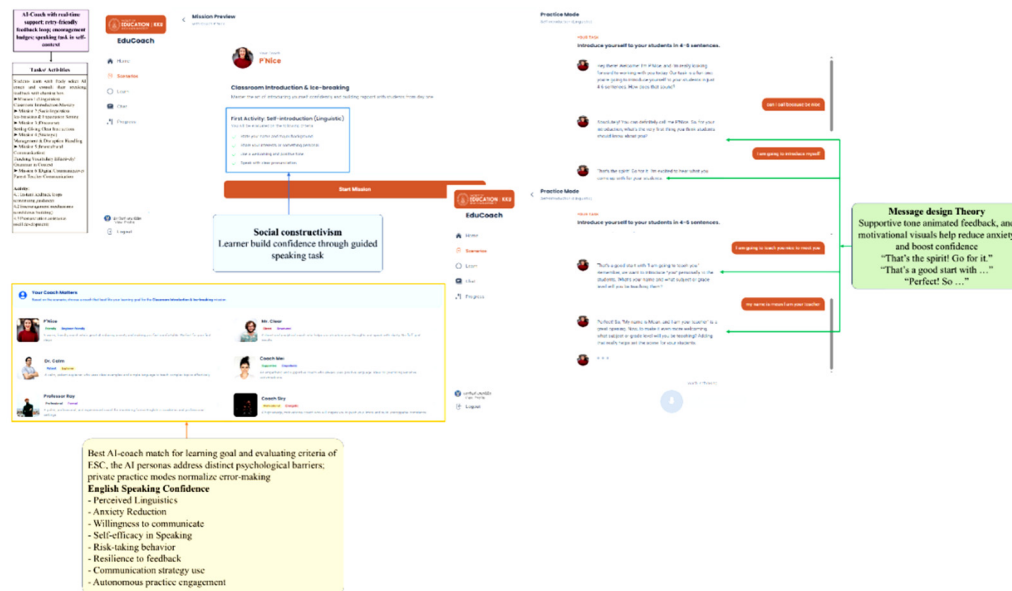


Figure 5. Activities of AI Coach with Real-Time Support

Component 5: Feedback and Retry Loop

The Feedback and Retry Loop implements constructive feedback principles (Hattie & Clarke, 2018) and student self-regulation theory (Flavell, 1979; Zimmerman, 2000a) through a four-phase progression model that treats speaking confidence and communicative competence as co-developing rather than sequential outcomes. Phase 1 (Foundation): builds initial confidence and basic competence through low-risk tasks. Phase 2 (Development): deepens competence through increasing challenge and learner autonomy. Phase 3 (Mastery): develops advanced competence through authentic professional scenarios requiring formal register. Phase 4 (Metacognition and Independence): cultivates self-assessment, peer teaching, and lifelong self-regulation capacity. Unlimited penalty-free retry operationalizes the orientation-planning-monitoring-evaluation cycle of student self-regulation, as illustrated in Figure 6.



Figure 6. Activities of Feedback and Retry Loop

Component 6: Progress Tracker

The Progress Tracker operationalizes Bandura's (1997) mastery-experience source of self-efficacy and Zimmerman and Moylan's (2009) self-regulation framework by rendering speaking development concrete, observable, and motivating. Eight English-speaking confidence dimensions are represented in the proposed measurement architecture through line graphs, radar charts, achievement badges, and streak-tracking features. These dimensions require psychometric validation with learner data in the next research phase. Seven proposed assessment instruments embedded in the Progress Tracker and Scaffolding Support Center are intended to longitudinally monitor confidence and competence development, as illustrated in Figure 7.

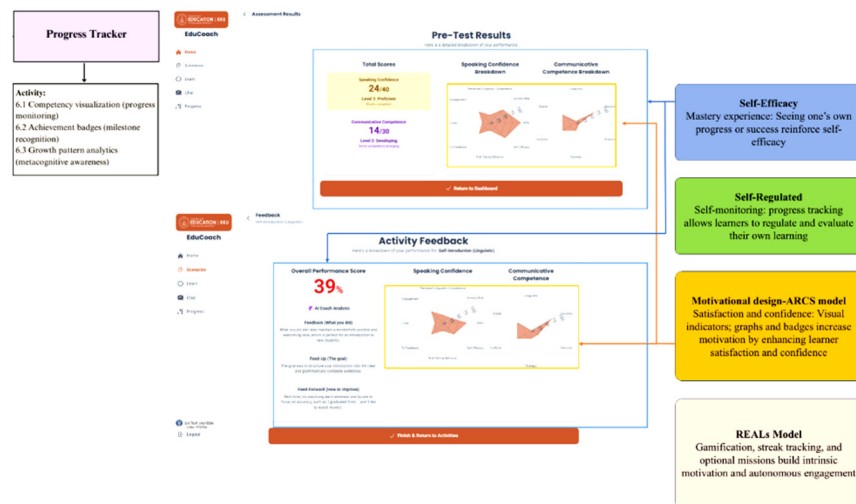


Figure 7. Activities of Progress Tracker

Component 7: Scaffolding Support Center

The Scaffolding Support Center implements Vygotsky's (1978) scaffolding principle, the OLEs model's scaffold design (Hannafin et al., 1999), and student self-regulation theory (Flavell, 1979) through three adjustable levels of instructional support: introductory, intermediate, and advanced, providing conceptual, strategic, and procedural assistance aligned with specific communicative tasks. Conceptual scaffolding supports learners in identifying and using appropriate learning resources. Metacognitive scaffolding guides self-monitoring and self-regulatory thinking. Procedural scaffolding orients learners to the operational features of the model. Strategic scaffolding equips learners with domain-specific problem-solving approaches for authentic speaking challenges. Reflective prompts at each scaffolding level stimulate the orientation and evaluation steps of student self-regulation, as illustrated in Figure 8.

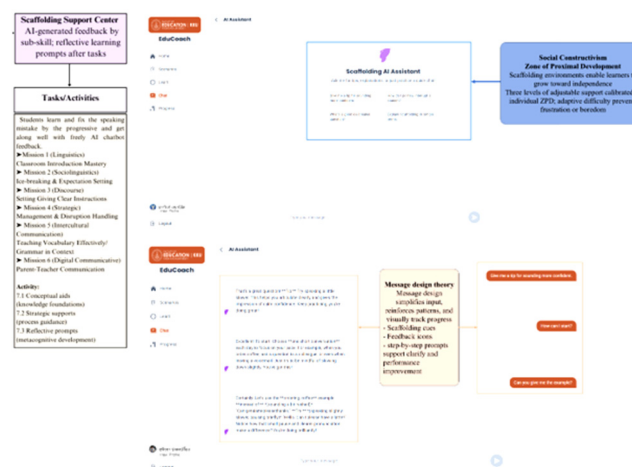


Figure 8. Activities of Scaffolding Support Center

3.4 Expert-Based Prototype Validation

The completed prototype was subjected to expert-based quantitative validation. Table 4 presents five evaluation dimensions: Content Quality, Pedagogical Design, Technical Functionality, User Interface Design, and Perceived Overall

Effectiveness. All dimensions exceeded the predetermined acceptance threshold of 4.00, and the overall prototype quality score was $M = 4.55$ ($SD = 0.38$). Perceived Overall Effectiveness received the highest mean score, $M = 4.76$ ($SD = 0.35$), followed by Pedagogical Design, $M = 4.68$ ($SD = 0.39$). Technical Functionality, although rated positively, had the lowest mean, $M = 4.36$ ($SD = 0.55$), identifying it as the priority domain for refinement. These scores represent expert judgments of design quality and feasibility; they do not constitute evidence of actual learning effectiveness.

Table 4. Expert Validation Results of the AI-Enhanced Mobile Learning Model Prototype

Dimension	Mean	SD	Scale Interpretation	Consensus Level
Content Quality	4.52	0.48	Agree–Strongly Agree	Strong Agreement
Pedagogical Design	4.68	0.39	Agree–Strongly Agree	Strong Agreement
Technical Functionality	4.36	0.55	Agree–Strongly Agree	Moderate Agreement
User Interface Design	4.44	0.51	Agree–Strongly Agree	Moderate Agreement
Perceived Overall Effectiveness	4.76	0.35	Strongly Agree	Strong Agreement
Overall Prototype Quality	4.55	0.38	Agree–Strongly Agree	Strong Agreement

Note. Ratings were provided by seven experts in English language teaching, educational technology, and teacher education who had not participated in the earlier model verification stage. Each dimension comprised 10 items measured on a 5-point Likert scale. All dimensions exceeded the prototype acceptance threshold of $M \geq 4.00$.

These results indicate that experts judged the prototype to be theoretically coherent, pedagogically appropriate, and sufficiently feasible to proceed to controlled usability and pilot testing. The strong ratings for Perceived Overall Effectiveness and Pedagogical Design reflect anticipated educational value rather than demonstrated learner improvement. Accordingly, progression to implementation should be conditional on meeting the technical benchmarks and learner-usability criteria specified below.

3.5 Technical Refinement and Verification Criteria

The lower Technical Functionality rating requires explicit verification before experimental deployment. The next prototype iteration should be tested against four proposed acceptance criteria: (a) speech-recognition word error rate of 15% or lower in a quiet environment and separate reporting for Thai-accented English; (b) median end-to-end feedback latency of 2 seconds or less and 95th-percentile latency of 4 seconds or less; (c) contextual interpretation accuracy of at least 85% on a researcher-developed set of representative teacher-education utterances; and (d) at least 99% crash-free sessions during pilot use. These values are design targets, not findings from the present study. Testing should also include noisy environments, low-bandwidth conditions, code-switching, ambiguous utterances, and data-privacy checks. Failed or low-confidence recognition should trigger clarification prompts rather than authoritative corrective feedback.

3.6 Practical Implementation Strategy

Implementation can be organized in three stages. First, institutions should establish minimum infrastructure comprising Android or iOS smartphones, headsets or microphones, stable wireless internet, secure cloud or institutional hosting, user authentication, encrypted data transmission, and a data-retention policy. Cost planning should distinguish one-time development and integration costs from recurring expenses for cloud hosting, speech-to-text processing, language-model usage, maintenance, technical support, and staff development. Second, faculty development should include short workshops on mission facilitation, interpretation of AI-generated feedback, ethical and privacy safeguards, troubleshooting, and procedures for overriding inaccurate AI feedback. Third, curriculum integration should begin with a four- to six-week supplementary module linked to existing speaking or English-for-teaching courses. Instructors should select missions that align with course outcomes, combine independent mobile practice with classroom debriefing, and use AI analytics formatively rather than as the sole basis for high-stakes grading.

3.7 Illustrative Learning Experience

An illustrative mission is “Explain a classroom activity to international students.” The learner receives the scenario, role, communicative goal, target language, and success criteria before recording a response. A possible exchange is: AI Coach: “Give the instructions in three clear steps and check whether the students understand.” Learner: “First, make a group four person and discuss about the picture.” AI Coach: “Your sequence is clear. Revise two phrases: say ‘form groups of four’ and ‘discuss the picture.’ Try the full instruction again, then add a comprehension-check question.” The feedback separates communicative success from language correction, provides a brief model, and invites an immediate retry. This example illustrates the intended interaction design and is not presented as empirical dialogue data.

4. Discussion

The findings indicate that experts perceived the proposed AI-Enhanced Mobile Learning Model through the EDU Coach application as theoretically coherent, pedagogically appropriate, and technically feasible for further development. All dimensions exceeded the predefined acceptance threshold, with the highest ratings assigned to Perceived Overall Effectiveness and Pedagogical Design. These results support the design quality of the prototype, but they should not be

interpreted as evidence that the model has already improved learners' English-speaking confidence or communicative competence. Such causal claims require learner-based usability, pilot, and experimental data.

One important contribution of this study lies in its integration of constructivist, cognitive, communicative, and technological theories into a unified instructional framework. Previous AI-assisted language learning systems have frequently emphasized isolated technological functions such as automated pronunciation scoring, chatbot interaction, or vocabulary practice without establishing explicit connections to broader pedagogical and cognitive learning theories. In contrast, the present model synthesized constructivist learning theory (Piaget, 1964; Vygotsky, 1978), situated learning (Brown et al., 1989), cognitive load theory (Sweller, 1994), communicative competence theory (Canale, 1987), and self-regulation theory (Zimmerman, 2000a) into operational prototype components. This multidimensional synthesis appears to have contributed substantially to the strong expert ratings for pedagogical design and overall effectiveness because the system was evaluated not merely as a technological tool, but as a theoretically informed learning ecosystem.

The strong evaluation of the pedagogical design dimension ($M = 4.68$, $SD = 0.39$) may be explained by the model's emphasis on authentic learning environments and situated communicative practice. Situated learning theory proposes that meaningful learning occurs when learners engage in authentic activities situated within realistic contexts (Brown et al., 1989; McLellan, 1996). The EDU Coach prototype operationalized this principle through mission-based communicative tasks reflecting realistic professional situations encountered by pre-service teachers. The inclusion of authentic classroom communication scenarios, role-based conversational practice, and contextualized speaking tasks likely enhanced the perceived authenticity and practical relevance of the model. These findings are consistent with Herrington and Oliver (2000), who argued that authentic learning environments support deeper engagement, transferable knowledge construction, and meaningful learning experiences.

The findings additionally reinforce the importance of psychological and affective dimensions in AI-enhanced language learning. English-speaking confidence has consistently been identified as a major determinant of learners' willingness to communicate in second-language contexts (MacIntyre et al., 1998). The EDU Coach prototype specifically addressed this issue through adaptive AI personas, low-anxiety practice environments, progressive difficulty levels, and supportive feedback mechanisms grounded in self-efficacy theory (Bandura, 1997). The Coach Selection Screen and AI Coach with Real-Time Support components operationalized social persuasion, mastery experiences, and emotional support, all of which are central mechanisms underlying self-efficacy development. The findings therefore support previous research suggesting that AI-supported learning environments can reduce communication anxiety and encourage repeated language practice through psychologically safe interaction spaces (Qiao & Zhao, 2023).

Another significant contribution of the study concerns the integration of self-regulated learning mechanisms within AI-supported mobile learning environments. Contemporary educational research increasingly emphasizes that learners must develop metacognitive monitoring, autonomous learning management, and reflective learning behaviors to succeed in digital learning environments (Flavell, 1979; Zimmerman & Moylan, 2009). The EDU Coach model operationalized these principles through the Feedback and Retry Loop and Progress Tracker components, which encouraged learners to monitor progress, reflect on communicative performance, and engage in iterative speaking practice. The unlimited retry system and multidimensional progress visualization transformed assessment from a summative judgment process into a formative developmental process. This design is theoretically consistent with Hattie and Clarke's (2018) argument that effective feedback should support ongoing improvement rather than merely evaluate performance outcomes.

The findings also highlight the growing importance of multimodal and AI-enhanced instructional design in mobile learning environments. The Learning Zone component integrated text, audio, graphics, animations, and AI-generated feedback into a unified hypermedia environment consistent with Kozma's (1991) media theory. Cognitive load reduction strategies such as chunked content presentation, progressive disclosure, and voice-first interaction design were additionally embedded into the system architecture. These design features likely contributed to the positive evaluations of user interface design and pedagogical usability because they aligned technological interaction with learners' cognitive processing capacities. This supports previous research suggesting that multimedia learning environments become more effective when instructional media are aligned with cognitive learning processes rather than simply increasing technological complexity (Sweller, 1994).

Although Technical Functionality received the lowest mean score ($M = 4.36$, $SD = 0.55$), it remained above the acceptance threshold. The relative weakness is substantively important because speech-enabled AI systems can be affected by accent variation, background noise, response latency, code-switching, and context-sensitive interpretation. The proposed verification criteria therefore prioritize word error rate, end-to-end latency, contextual interpretation accuracy, crash-free sessions, and safe handling of low-confidence recognition. Reporting these metrics in the next phase will allow technical quality to be assessed with objective evidence rather than expert perception alone.

From a theoretical perspective, this study extends current understanding of AI-enhanced mobile learning by demonstrating how communicative competence development, self-regulation, cognitive learning principles, and adaptive AI

technologies can be integrated within a single conceptual framework. Existing studies have often examined these domains independently. In contrast, the present study proposes a holistic framework in which communicative competence, speaking confidence, AI-supported scaffolding, and self-regulated learning operate as interconnected dimensions within authentic mobile learning environments. This theoretical integration contributes to emerging discussions concerning the pedagogical transformation of AI from a purely technological support tool into an adaptive instructional partner capable of facilitating cognitive, emotional, and communicative learning processes.

Practically, the EDU Coach prototype offers significant implications for English language education, teacher preparation programs, and AI-enhanced instructional design. The mobile-first structure of the model enables flexible and asynchronous learning opportunities suitable for contemporary university students who increasingly rely on mobile devices for educational access. The model may additionally provide an alternative instructional approach for educational institutions seeking to improve learners' communicative competence while addressing persistent challenges associated with speaking anxiety and limited authentic language exposure. Because the system was specifically contextualized for Thai pre-service teachers, the framework may also serve as a culturally responsive instructional model adaptable to other EFL contexts characterized by similar communication barriers and instructional limitations.

Several limitations should be acknowledged. First, the study focused on conceptual framework development and expert-based prototype validation rather than implementation with learners. It therefore provides evidence of perceived quality and appropriateness, not actual effectiveness, usability, learning gain, anxiety reduction, or sustained engagement. Second, the expert panel was purposively selected and relatively small, which is appropriate for formative design review but limits statistical generalization. Third, the proposed AI functions, confidence dimensions, and assessment instruments have not yet been technically or psychometrically validated. Fourth, the prototype was contextualized for Thai pre-service teacher education, and transfer to other populations requires cultural, linguistic, and curricular adaptation. Future research should proceed sequentially through technical benchmarking, learner-based usability testing, a small pilot, instrument validation, and a controlled effectiveness study with delayed follow-up.

5. Conclusion

This study proposed and developed the Conceptual Framework of an AI-Enhanced Mobile Learning Model, implemented through the EDU Coach application, to improve English-speaking confidence and communicative competence among pre-service education students. The model was systematically synthesized from multidisciplinary theoretical foundations, including constructivist theory, cognitive theory, communicative competence theory, self-efficacy theory, self-regulated learning theory, media theory, and authentic technology-based learning principles. These theoretical foundations were operationalized into seven integrated prototype components designed to support authentic communicative learning, adaptive AI-supported interaction, scaffolding, metacognitive regulation, and confidence development within mobile learning environments.

The expert-validation findings were positive across content quality, pedagogical design, technical functionality, user interface design, and perceived overall effectiveness. The overall rating indicates that the prototype has sufficient theoretical coherence, instructional appropriateness, and perceived feasibility to proceed to learner-based testing. The findings do not yet demonstrate improvements in speaking confidence or communicative competence.

This study contributes to the theoretical literature by extending the current understanding of AI-enhanced mobile learning through the integration of communicative competence development, English-speaking confidence, adaptive scaffolding, and self-regulated learning within a unified instructional framework. Unlike many existing AI-assisted language learning systems that emphasize isolated technological functions, the EDU Coach model demonstrates how AI technologies can function as adaptive pedagogical partners supporting cognitive, affective, and communicative dimensions of language learning simultaneously.

From a practical perspective, the EDU Coach application provides a prototype framework for designing AI-enhanced English communication learning environments suitable for pre-service teacher education and similar EFL contexts. The model offers flexible, authentic, and learner-centered communication practices that may help address persistent challenges related to speaking anxiety, limited opportunities for authentic interaction, and low learner confidence in English communication. The mobile-first architecture also supports asynchronous, personalized learning experiences aligned with the learning behaviors of contemporary university students.

Despite these contributions, the study remains limited to conceptual framework development and expert-based prototype validation. Therefore, future research should conduct experimental implementation studies to examine the effectiveness of the EDU Coach model on learners' communicative competence, speaking confidence, self-regulated learning behaviors, and long-term engagement outcomes. Further investigation should also explore AI personalization mechanisms, learning analytics integration, cross-cultural applicability, and large-scale deployment in diverse educational environments.

Overall, the study supports continued development of pedagogically grounded AI-enhanced mobile learning for authentic communication, adaptive support, learner autonomy, and confidence development. The next research phase must establish

technical performance, usability, psychometric quality, and causal learning effects before claims of educational effectiveness can be made.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During manuscript revision, the authors used a generative AI language tool to support language editing, readability improvement, and organization of responses to reviewer comments. The authors critically reviewed and edited all generated content and take full responsibility for the accuracy, integrity, originality, references, interpretations, and conclusions of the manuscript. No AI tool was used to generate or alter research data, expert ratings, or statistical results.

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Author contributions

Wantipa Unarat: conceptualization, methodology, investigation, data curation, formal analysis, writing – original draft, review & editing, Associate Professor. Dr. Parama Kwangmuang and Dr. Wanwisa Wannapipat: supervision, resources, formal analysis. All authors approved the final version of the article.

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Data sharing statement

No additional data are available.

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