
RESEARCH ARTICLE

Augmented Reality in Computer-Assisted Language Learning: A Critical Review of Recent Literature (2020-2025)

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ABSTRACT

Augmented Reality (AR) has gained increasing attention within Computer-Assisted Language Learning (CALL) and Technology-Enhanced Language Learning (TELL) due to its potential to support immersive, contextualised, and interactive language learning experiences. Despite the growing body of research in this area, findings regarding the educational effectiveness of AR remain inconsistent, particularly in relation to sustained linguistic development and communicative competence. In response to this situation, the present study provides a structured critical review with an interpretative orientation of recent research on AR-assisted language learning published between 2020 and 2025. A corpus of 27 publications, including empirical studies, systematic reviews, meta-analyses, and theoretical contributions, was critically examined in order to identify dominant implementation patterns, recurrent learning outcomes, and the pedagogical and contextual conditions shaping the educational role of AR in language learning environments. The analysis focused on recurring themes related to learner engagement, situated interaction, instructional mediation, cognitive processing, and communicative participation across different educational contexts. The findings indicate that AR frequently enhances learner motivation, participation, and experiential engagement through multimodal and context-sensitive interaction. However, the review also suggests that positive affective responses do not consistently translate into equivalent linguistic gains. Variability across studies appears closely associated with differences in instructional design, task organisation, cognitive load management, and the degree to which immersive interaction remains pedagogically structured. Building on these findings, the study proposes the Conditional Affordance Model of AR in Language Learning as a theoretical framework for interpreting how technological affordances, instructional mediation, situated participation, and cognitive processing interact to shape language learning outcomes. Rather than conceptualising AR as an inherently transformative educational technology, the model positions immersive learning as pedagogically conditional and context-dependent. The study contributes to current discussions surrounding immersive language learning by offering a theoretically grounded interpretation of AR-assisted language education while also identifying methodological and pedagogical challenges that continue to affect the implementation of immersive technologies within contemporary language classrooms.

KEYWORDS

Affordance Theory, Augmented Reality, Computer-Assisted Language Learning (CALL), Immersive Learning, Technology-Enhanced Language Learning (TELL)

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1. Introduction

The rapid expansion of immersive technologies has significantly transformed contemporary discussions surrounding digital education and technology-enhanced learning. Among these emerging technologies, Augmented Reality (AR) has attracted growing attention within Computer-Assisted Language Learning (CALL) and Technology-Enhanced Language Learning (TELL) due to its potential to combine physical and digital environments in ways that support contextualised, interactive, and multimodal learning experiences. Unlike fully virtual environments, AR overlays digital information onto real-world settings, allowing learners to interact simultaneously with physical surroundings and digitally mediated content (Milgram and Kishino, 1994). This capacity

for situated and environment-based interaction has positioned AR as a promising tool for language learning, particularly in relation to vocabulary acquisition, communicative participation, learner engagement, and experiential learning practices.

Recent years have witnessed a substantial increase in research exploring the integration of AR within language education. Existing studies have examined the role of AR across a wide range of educational contexts, including English as a Foreign Language (EFL), English as a Second Language (ESL), bilingual education, Content and Language Integrated Learning (CLIL), and mobile-assisted language learning environments. Across this growing body of literature, AR has frequently been associated with increased learner motivation, stronger participation, enhanced interaction, and more immersive forms of communicative engagement (Akçayır and Akçayır, 2017; Chen et al., 2020; Parmaxi and Demetriou, 2020). In many cases, immersive and multimodal environments appear to encourage exploratory learning, collaborative interaction, and situated language use by embedding communicative activities within context-sensitive tasks and digitally enriched physical spaces.

At the same time, the educational effectiveness of AR-assisted language learning remains far from conclusive. Although many studies report positive affective outcomes associated with engagement and motivation, evidence regarding sustained linguistic development remains considerably more heterogeneous. Reported gains in vocabulary retention, communicative competence, pronunciation, interactional fluency, and broader language acquisition frequently vary according to instructional design, task organisation, learner characteristics, technological accessibility, and classroom implementation conditions. As a result, the current literature presents a fragmented picture in which immersive engagement does not consistently translate into equivalent linguistic outcomes.

This variability suggests that the educational role of AR cannot be adequately understood through technologically deterministic assumptions that treat immersion itself as inherently transformative. While immersive technologies may create opportunities for interaction and participation, the reviewed literature increasingly indicates that learning outcomes depend heavily on how AR environments are pedagogically structured and integrated into communicative activity. Factors such as instructional mediation, cognitive load management, task sequencing, collaborative participation, and contextual alignment appear to play a significant role in shaping the effectiveness of immersive language learning experiences.

Despite the growing volume of research in this area, much of the existing literature remains primarily descriptive, often focusing on technological novelty or short-term motivational outcomes without sufficiently addressing the pedagogical and cognitive conditions influencing linguistic development. In addition, many studies continue to conceptualise AR effectiveness in relatively linear terms, implicitly assuming that increased immersion automatically produces improved learning outcomes. Comparatively less attention has been devoted to developing theoretically grounded interpretations capable of explaining why AR environments generate highly uneven educational results across different learning contexts.

Rather than aiming for exhaustive bibliometric coverage in the manner of a formal systematic review, the present study adopts a structured critical and interpretative review approach focused on identifying pedagogical, contextual, and theoretical patterns across recent AR-assisted language learning research. The objective is not to aggregate findings statistically, but to develop a theoretically grounded interpretation of how immersive technologies are being operationalised within contemporary language education.

Accordingly, the present study critically examines recent research on AR-assisted language learning published between 2020 and 2025 in order to explore how immersive environments are being implemented across language education contexts, which pedagogical patterns emerge most consistently across the literature, and why linguistic outcomes remain variable despite widespread reports of increased learner engagement. The study ultimately proposes the Conditional Affordance Model of AR in Language Learning as a conceptual framework for interpreting how technological affordances, instructional mediation, situated participation, and cognitive mediation interact to shape language learning outcomes across different educational settings.

To address these objectives, the study is guided by the following research questions:

1. How has Augmented Reality been implemented within recent language learning research between 2020 and 2025?
2. What pedagogical, cognitive, and contextual patterns emerge across recent AR-assisted language learning studies?
3. How do instructional organisation, situated participation, and cognitive mediation appear to influence the educational effectiveness of AR-assisted language learning environments?
4. How can the Conditional Affordance Model contribute to interpreting the variability of linguistic outcomes reported across AR-assisted language learning research?

2. Methodology

2.1 Research Design

The present study adopts a structured critical review design with an interpretative orientation. Rather than aiming to produce statistical aggregation of findings, the review seeks to identify recurring patterns, implementation tendencies, and the pedagogical and contextual conditions shaping the use of Augmented Reality (AR) in language learning environments. In this sense, the study combines descriptive synthesis with conceptual interpretation in order to examine how AR has been integrated, understood, and operationalised across different educational contexts.

The review focuses on publications produced between 2020 and 2025. This period was selected due to the considerable expansion of educational research on immersive technologies following the increasing accessibility of mobile devices, AR applications, and digitally mediated learning environments. During these years, AR became progressively more visible within CALL, TELL, and broader technology-enhanced language learning research, particularly in relation to multimodal interaction, situated learning, and experiential classroom practices.

The analytical corpus includes empirical studies, systematic reviews, meta-analyses, and theoretical contributions relevant to AR-assisted language learning. Including different types of publications allowed for a broader understanding of the field by combining evidence from classroom interventions with conceptual and methodological discussions surrounding immersive language learning environments.

Accordingly, the study prioritises analytical depth and interpretative understanding over exhaustive bibliometric coverage. The review is therefore situated within a critical interpretative perspective that approaches educational technology not as an isolated technical phenomenon, but as a pedagogically and contextually mediated process shaped by instructional practices, learner interaction, and educational conditions.

2.2 Data Sources and Search Strategies

Given the interdisciplinary nature of AR-assisted language learning research, Google Scholar was selected as the principal search platform. This decision was based on its broad coverage across fields such as educational technology, applied linguistics, CALL, immersive learning, and digital pedagogy. Compared to more specialised databases, Google Scholar allows access to publications distributed across diverse academic venues, which was considered particularly relevant in a field characterised by rapid technological development and strong cross-disciplinary overlap.

The search process combined terms related to Augmented Reality and language learning through the use of Boolean operators. The main search strings included combinations such as:

- "Augmented Reality" AND "language learning"
- "AR" AND "foreign language education"
- "Augmented Reality" AND "vocabulary acquisition"
- "Augmented Reality" AND "CALL"
- "AR" AND "second language learning"

Search terms were progressively refined throughout the review process in order to improve relevance and reduce the inclusion of studies unrelated to educational or language learning contexts. Additional searches were also conducted when recurrent concepts or implementation tendencies emerged during the analytical review process.

To ensure academic relevance and minimum quality standards, only peer-reviewed journal articles, conference papers, systematic reviews, meta-analyses, and academically recognised publications were considered for inclusion. Non-academic sources, duplicate records, and publications unrelated to language education were excluded during the review process.

The search strategy prioritised conceptual relevance and educational contribution rather than exhaustive bibliometric retrieval. Accordingly, the objective was not to identify every publication related to AR and language learning, but to construct a conceptually meaningful corpus capable of supporting a critical and theoretically informed interpretation of current tendencies within the field.

2.3 Study Identification and Selection

The initial search generated a broad corpus of publications related to Augmented Reality and language learning. Following the identification stage, titles and abstracts were examined in order to determine their relevance to the objectives of the study. Publications focusing exclusively on Virtual Reality, non-educational uses of AR, or technological applications unrelated to language learning were excluded during this phase.

After the initial analytical review, the remaining studies were examined through full-text reading. This stage focused on evaluating the relevance of each publication in relation to the research questions, particularly regarding instructional implementation, reported learning outcomes, theoretical perspectives, and contextual conditions surrounding the use of AR in foreign and second language education.

The review ultimately focused on 27 publications published between 2020 and 2025. The selected studies included empirical research, systematic reviews, meta-analyses, and theoretical or contextual contributions related to AR-assisted language learning. The diversity of publication types allowed the review to combine evidence from classroom-based interventions with broader conceptual discussions concerning immersive learning environments and educational technology.

The inclusion criteria were the following:

- publications published between 2020 and 2025;
- studies or reviews related to AR, immersive learning, CALL, TELL, or MALL in language education;
- empirical, theoretical, review-based, or meta-analytical contributions relevant to the research questions;
- publications written in English or Spanish;
- peer-reviewed journal articles, conference papers, or academically recognised research outputs.

The exclusion criteria included:

- publications unrelated to language education;
- studies focused exclusively on Virtual Reality without connection to AR or immersive language learning;
- non-academic sources;
- duplicate records;
- inaccessible full texts.

2.4 Analytical Examination and Thematic Coding

The selected publications were examined manually through full-text analytical reading. Relevant information from each study was progressively organised in order to facilitate comparison across the corpus and identify recurring pedagogical, contextual, and methodological tendencies within AR-assisted language learning research.

The analytical examination included aspects such as:

- educational context;
- type of AR implementation;
- targeted language skills;
- reported learning outcomes;
- affective outcomes;
- duration of the intervention;
- methodological design;
- and reported limitations.

Following the analytical review process, the studies were examined through an iterative thematic coding approach aimed at identifying recurrent tendencies related to implementation models, learning outcomes, instructional approaches, and contextual factors shaping the use of AR within language learning environments.

Throughout the analysis, publications were progressively grouped according to broader analytical categories that emerged recurrently across the corpus. Three main implementation tendencies became particularly visible:

1. overlay-based vocabulary applications;
2. gamified or task-based AR environments;
3. situated and experiential AR learning approaches.

These categories were treated as flexible analytical tendencies rather than rigid classifications, as several studies combined characteristics from multiple implementation models. Nevertheless, they provided a useful conceptual structure for examining how AR affordances were operationalised across different instructional contexts. The coding process also focused on identifying broader conceptual patterns related to learner engagement, communicative interaction, instructional mediation, and contextual implementation conditions. Rather than prioritising statistical categorisation, the analysis emphasised interpretative coherence and conceptual depth.

This iterative analytical process ultimately provided the basis for the development of the Conditional Affordance Model proposed in this study. The model emerged progressively through repeated comparison across studies, theoretical perspectives, and

recurring instructional patterns identified throughout the review. The recurring relationships identified across the reviewed studies progressively informed the development of the Conditional Affordance Model proposed in Section 4.3. In this sense, the model emerged inductively through repeated comparison between instructional practices, learner participation patterns, cognitive demands, and reported linguistic outcomes across the analytical corpus.

2.5 Table Strategy and Data Organisation

In order to facilitate comparison across studies, the selected publications were organised into a comparative table summarising the main characteristics of each contribution. The table includes information related to educational context, type of AR implementation, methodological approach, and principal findings. This organisation made it possible to identify recurring patterns, implementation tendencies, and differences across the analysed literature more clearly.

Table 1. Overview of the selected publications

Author(s)	Type of contribution	Context	AR Type	Main Outcome
Belda-Medina And Marrahi-Gómez (2023)	Empirical mixed-method study	Secondary EFL education	AR-based vocabulary learning	Reported high levels of learner motivation and positive attitudes towards AR integration, although no significant differences were found in vocabulary acquisition compared to traditional instruction.
Subirats-Blanco and Conde del Rio (2024)	Qualitative review and pedagogical proposal	Primary EFL education	AR integration for communicative competence and vocabulary learning	Emphasised the pedagogical potential of AR for improving learner motivation, communicative competence, and student autonomy, while also identifying infrastructural and accessibility limitations.
Caetano et al. (2024)	Empirical experimental study	Outdoor Portuguese vocabulary learning	Mobile outdoor AR vocabulary labelling	Demonstrated strong learner preference for AR-supported contextual vocabulary learning over flashcard-based approaches, highlighting the potential of situated mobile learning environments.
Cai et al. (2022)	Meta-analysis	AR-assisted language learning	Effectiveness of AR on language gains and motivation	Identified generally positive effects of AR on language learning gains and moderate effects on learner motivation, while highlighting the influence of educational level and intervention duration as moderating factors.
Gabarrón Pérez et al. (2020)	Theoretical and contextual review	CALL and language education	Evolution of CALL and emerging technologies	Provided a broad overview of the evolution of CALL, including mobile learning, gamification, and immersive technologies, situating AR within wider transformations in technology-enhanced language education.
Gil Parga et al. (2024)	Systematic review	Educational applications of AR	Pedagogical design and AR implementation	Identified that AR is particularly effective for practice-oriented and contextual learning scenarios, while also highlighting poor pedagogical design and usability issues as recurrent limitations.
Iberahim et al. (2023)	Theoretical review	Technology-enhanced language learning (TELL)	Educational uses and challenges of TELL	Discussed the pedagogical benefits and limitations of technology-enhanced language learning, emphasising both the opportunities and risks associated with unsupervised or poorly mediated technology use.
Iftikhar (2025)	Mixed-methods study	Mobile-assisted second language learning	MALL and mobile language learning	Highlighted the potential of mobile-assisted language learning to increase learner motivation, accessibility, and self-directed learning, while identifying digital literacy and pedagogical structure as major implementation challenges.
Khodabandeh and Mombini (2024)	Empirical quasi-experimental study	High school EFL education	AR-supported vocabulary learning in flipped and	Reported positive effects of AR integration on vocabulary learning, learner self-efficacy, and personality-related variables within flipped and blended instructional environments.

Kurniawan et al. (2024)	Mixed-methods study	Higher education language learning	blended learning AR integration through Assemblr Studio	Reported positive effects of AR-supported learning environments on learner engagement, speaking, and writing skills through interactive and personalised language learning experiences.
Liao et al. (2024)	Mixed-methods comparative study	Elementary EFL education	AR game-based language learning	Demonstrated that AR-supported game-based learning improved vocabulary, speaking, listening, learner motivation, and engagement, with stronger gains observed among rural learners.
Liu et al. (2023)	Mixed-methods experimental study	Chinese EFL education	AR for intercultural competence and L2 motivation	Found that AR-based instruction significantly enhanced intercultural competence, learner motivation, and cultural engagement through contextualised and immersive language learning activities.
Marrahi-Gómez and Belda-Medina (2024)	Mixed-methods empirical study	Secondary EFL education	AR-supported grammar learning	Reported high learner motivation and positive attitudes towards AR integration in grammar instruction, although no statistically significant improvements in grammar performance were identified.
Mena et al. (2023)	Systematic literature review	Teacher education and professional training	AR in teacher preparation	Highlighted the limited implementation of AR in teacher education and emphasised the need for more pedagogically oriented research on AR-supported teacher training processes.
Palzer et al. (2024)	Conceptual and exploratory study	AR learning environments	Narrative and physical contextualisation in AR	Explored how narrative structures and physical contextualisation may shape learner interaction and meaning-making processes within AR-supported educational environments.
Parlar and Sütçü (2025)	Quasi-experimental study	Secondary EFL education	Situated AR-supported listening instruction	Reported significant improvements in listening performance, learner motivation, and positive attitudes towards AR-supported situated language learning environments.
Rahman (2025)	Theoretical and contextual review	Bilingual language education	CALL, TELL, and AR in bilingual learning	Discussed the theoretical foundations and pedagogical implications of technology-enhanced bilingual language learning, emphasising the importance of cognitive, sociocultural, and constructivist perspectives.
Ribeiro et al. (2024)	Technological and conceptual study	Museum and cultural heritage learning environments	AR, VR, gamification, and AI for contextual learning	Proposed an integrated immersive learning system combining AR, VR, gamification, and AI to support contextualised cultural interaction, accessibility, and engagement within museum environments.
Ronaghi and Ronaghi (2022)	Mixed-methods contextual study	Tourism and cultural heritage contexts	User acceptance of AR technologies	Identified enjoyment, social influence, and effort expectancy as key factors shaping user acceptance and perceived value of AR-supported experiences.
Shadiev and Liang (2023)	Systematic review	AR-supported language learning research	Technologies, pedagogical approaches, and outcomes in AR language learning	Identified vocabulary acquisition, learner engagement, and motivation as the most recurrent outcomes in AR-supported language learning, while also highlighting methodological and implementation challenges.
Silva et al. (2024)	Design-based research study	Educational AR authoring and teacher design needs	Pedagogical design principles for AR authoring tools	Proposed pedagogically oriented design principles for AR educational authoring tools and highlighted the limited pedagogical support available in many existing AR platforms.

El Shemy et al. (2024)	Systematic literature review	Language learning for children with autism spectrum disorder	AR-enhanced language interventions	Reported that AR-supported interventions may enhance communication, attention, emotional engagement, and language use among autistic children while emphasising the need for further empirical research.
Topu et al. (2024)	Quasi-experimental study	Pre-school English education	AR-supported vocabulary learning	Found significant improvements in vocabulary learning, enjoyment, and learner attitudes among pre-school children using AR-supported instructional activities.
Tran et al. (2024)	Systematic review	Technology-enhanced language learning (TELL)	AR applications and language acquisition	Reported that vocabulary acquisition was the most frequently identified benefit of AR-supported language learning while emphasising the predominance of mobile-based AR applications and the underexploration of broader language skills.
Voreopoulou, Mystakidis, and Tsinakos (2024)	Qualitative design and evaluation study	English as a Foreign Language (EFL) learning	AR-powered escape classroom game	Reported that AR-supported escape classroom games may promote deep and meaningful language learning by enhancing motivation, collaboration, cultural awareness, vocabulary retention, and receptive and productive language skills through interactive and playful communicative activities.
Wedyan, Falah, Elshaweesh, Alfalah, and Alazab (2022)	Mixed-methods study and systematic literature review	English as a Foreign Language (EFL) education	AR-supported English language learning	Reported that AR may improve English language skills, academic achievement, learner engagement, collaboration, creativity, and positive attitudes toward language learning, while also reducing learner anxiety and highlighting implementation challenges.
Yi et al. (2024)	Systematic review	Game-based ESL learning	AR-supported game-based language learning	Reported that AR-enhanced game-based learning environments increase learner engagement, satisfaction, and motivation, although technical, financial, and pedagogical barriers continue to affect implementation.

2.6 Methodological Limitations

Several methodological limitations should be considered when interpreting the findings of this review.

First, the study relied primarily on Google Scholar as the principal search platform. Although this database offers broad interdisciplinary coverage and facilitates access to recent publications across educational technology, CALL, applied linguistics, and immersive learning research, some relevant studies indexed exclusively in specialised databases may not have been identified.

Another important limitation concerns the considerable heterogeneity across the reviewed studies. Differences in research design, intervention duration, educational level, technological tools, and assessment procedures complicate direct comparison between findings and limit the generalisability of conclusions. In particular, many studies relied on short-term interventions and immediate post-tests, making it difficult to evaluate the long-term impact of AR on sustained language development, retention, or communicative competence.

The interpretative orientation of the review should also be acknowledged as a methodological limitation. Although the analytical process was conducted systematically and iteratively, the identification of conceptual patterns and thematic tendencies inevitably involves a degree of analytical subjectivity. Alternative interpretations of the reviewed literature may therefore remain possible.

Despite these limitations, the review provides a structured overview of recent developments in AR-assisted language learning and offers a theoretically informed interpretation of the conditions shaping the educational role of AR within contemporary language education.

3. Results

3.1 Overview of Selected Studies

The final corpus consisted of 27 publications published between 2020 and 2025, including empirical studies, systematic reviews, meta-analyses, and theoretical contributions related to AR-assisted language learning. Overall, the analysed literature reflects the growing interest in Augmented Reality within CALL and broader technology-enhanced language learning research, particularly in relation to immersive, mobile, and interactive learning environments (Shadiev and Liang, 2023; Tran et al., 2024).

The reviewed studies were conducted across a wide range of educational contexts, although most of them were situated in Asia and Europe. A smaller number of publications focused on Middle Eastern and Latin American educational settings, while comparatively limited research examined AR implementation in under-resourced environments or contexts characterised by restricted technological access. From a methodological perspective, the corpus included quantitative, qualitative, and mixed-methods approaches. However, short-term quasi-experimental interventions were the most common research design across the analysed studies. In many cases, researchers relied on relatively small participant groups and evaluated learning outcomes through pre- and post-tests, learner perception questionnaires, or classroom observations (Schorr et al., 2024; Tran et al., 2024).

In terms of research focus, vocabulary acquisition emerged as the most extensively investigated area. This tendency was particularly visible in studies examining overlay-based AR applications designed to connect vocabulary learning with multimodal and visual interaction. Other recurrent themes included learner motivation, engagement, participation, and task interaction. By contrast, broader dimensions such as communicative competence, long-term retention, pragmatic development, and sustained language acquisition received considerably less attention across the reviewed literature.

Another visible characteristic of the analysed studies is their strong contextual specificity. Most interventions were implemented within controlled educational environments supported by relatively favourable technological conditions and structured classroom settings. As a result, the literature reveals substantial variation in implementation models, instructional approaches, and technological configurations.

Overall, the reviewed studies illustrate the rapid expansion and increasing diversification of AR research within language education between 2020 and 2025. At the same time, the literature continues to show important methodological and contextual variation, reflecting the still evolving and heterogeneous nature of the field.

3.2 Typology of AR Implementations in Language Learning

The analysis of the reviewed studies revealed three main ways in which AR has been implemented within language learning environments. Although some interventions combined elements from different approaches, most studies could be grouped into three broader categories: overlay-based vocabulary applications, gamified and task-based AR environments, and situated experiential learning approaches. These categories reflect different instructional orientations and different ways of integrating AR into language learning activities.

3.2.1 Overlay-based vocabulary applications

Overlay-based vocabulary applications represented the most common type of AR implementation across the reviewed literature, particularly within English as a Foreign Language (EFL) contexts. These interventions typically involved the use of smartphones or tablet-based applications to superimpose digital vocabulary content onto physical objects, classroom materials, images, or real-world environments.

Most of these studies focused on vocabulary acquisition through multimodal interaction. Learners usually accessed lexical information by scanning markers, images, or surrounding objects that triggered visual, textual, or auditory content. This allowed vocabulary items to be connected to concrete referents and contextual cues, creating more situated forms of lexical exposure (Caetano et al., 2023). A recurrent characteristic of these interventions was the integration of multimodal support elements such as pronunciation models, animations, visual prompts, translations, or audio explanations. Several studies associated these features with increased learner attention and more active participation during vocabulary-related tasks (Belda-Medina and Marrahi-Gómez, 2023; Marrahi-Gómez and Belda-Medina, 2023).

The predominance of vocabulary-focused applications appears closely connected to the relationship between AR affordances and lexical learning processes. AR allows vocabulary items to be linked directly to visual and spatial references, making it especially suitable for concrete vocabulary instruction and environmentally embedded lexical exposure. This type of implementation was identified across different educational levels, including primary education, secondary education, higher education, and early childhood contexts (Blanco and Conde, 2024; Topu et al., 2024). Some studies also explored AR-assisted vocabulary learning with learners requiring multimodal or adaptive support, including students with specific educational needs (Shemy et al., 2024).

Despite differences in technological complexity and classroom implementation, overlay-based applications consistently emerged as the most consolidated and widely researched form of AR integration within the analysed literature. Overall, the reviewed studies suggest that current AR research in language education continues to prioritise vocabulary learning and multimodal lexical support as central areas of application.

3.2.2 Gamified and task-based AR environments

A second major implementation pattern identified across the reviewed studies involved the use of AR within gamified and task-based learning environments. Unlike overlay-based applications mainly centred on vocabulary presentation, these interventions used AR to organise interactive activities where learners participated in problem-solving, collaborative tasks, and communicative exchanges within digitally enhanced environments.

Many of these environments incorporated game-like elements such as missions, challenges, rewards, role-play situations, or location-based interaction. Learners were often required to complete tasks by interacting with both physical and digital elements while using the target language to exchange information, solve problems, or negotiate meaning (Hoe et al., 2024; Kurniawan et al., 2024). One of the most visible characteristics of this type of implementation was its emphasis on active learner participation. Rather than focusing only on vocabulary exposure, these activities attempted to place language use within dynamic task sequences designed to promote interaction, collaboration, and experiential engagement. In many cases, learners worked with peers, explored augmented spaces, or participated in communicative activities integrated into game-based structures.

Several studies associated these environments with increased learner participation and more positive perceptions of classroom interaction (Voreopoulou et al., 2024). Compared to more traditional instructional approaches, gamified AR activities were frequently described as more interactive, immersive, and socially engaging. This tendency was especially visible in interventions involving collaborative problem-solving or role-play interaction.

Another recurrent trend within this category was the growing connection between AR and task-based language learning approaches. In many interventions, AR technologies were integrated into communicative activities requiring learners to process information, complete objectives, or interact within situated scenarios. This reflects a broader movement towards learner-centred and experiential approaches within technology-enhanced language education. At the same time, the reviewed studies showed substantial variation in the design and complexity of these environments. Some interventions relied on relatively simple mobile-based activities, while others incorporated more elaborate collaborative experiences involving multiple stages of interaction and exploration.

Overall, gamified and task-based AR environments represent a shift from using AR mainly as a vocabulary support tool towards using it as a medium for communicative and participatory language learning experiences. Across the analysed studies, these interventions consistently emphasised interaction, task participation, and communicative activity as central components of the learning process.

3.2.3 Situated and experiential AR learning

A third implementation pattern identified across the analysed literature involved situated and experiential approaches to AR-assisted language learning. Unlike vocabulary-focused applications or explicitly gamified environments, these interventions attempted to connect language learning with physical spaces, real-world interaction, and context-sensitive learning experiences. These implementations were commonly associated with activities taking place in classrooms, museums, urban environments, cultural spaces, or location-based learning settings. Through smartphones, tablets, or location-sensitive applications, learners interacted with digital information embedded within their surroundings while participating in language-related activities and communicative tasks.

One of the most recurrent characteristics of situated AR learning was its emphasis on contextualised meaning-making. Rather than interacting with isolated vocabulary items or decontextualised exercises, learners engaged with language within environments that connected communication, spatial interaction, and contextual information (Liu et al., 2023; Ribeiro et al., 2024). Several studies also incorporated collaborative and exploratory dynamics into these activities. Learners frequently navigated physical spaces, interpreted contextual information, or completed tasks requiring interaction with peers while engaging with augmented content. In many cases, AR functioned as a tool for integrating language use into experiential and environment-based learning processes.

Another visible trend within this category was the integration of cultural and intercultural dimensions into immersive learning activities. Some interventions explored how AR could support interaction with culturally situated materials, local environments, or context-sensitive communicative scenarios, particularly in studies attempting to connect language learning with authentic social

or cultural experiences (Palzer et al., 2024; Ribeiro et al., 2024). The analysed studies also showed considerable variation in the complexity of these experiences. Some interventions relied on relatively simple location-based activities, while others incorporated more immersive exploratory environments combining spatial interaction, collaboration, and contextual information processing.

Collectively, situated and experiential AR learning approaches reflect a broader movement towards context-sensitive and environment-based forms of language education. Across the reviewed studies, these interventions consistently highlighted the relationship between language use, physical context, and experiential interaction as central components of the learning process.

3.3 Reported Learning Outcomes

3.3.1 Vocabulary acquisition

Vocabulary acquisition emerged as the most consistently examined learning outcome across the reviewed studies. A substantial part of the literature focused on exploring how AR could support lexical development, particularly through applications combining visual, spatial, and multimodal forms of input (Caetano et al., 2023; Khodabandeh and Mombini, 2024; Marrahi-Gómez and Belda-Medina, 2023).

Across many interventions, learners showed improvements in vocabulary recognition, recall, and short-term retention after participating in AR-mediated learning activities. These outcomes were frequently associated with the multimodal characteristics of AR environments, where vocabulary items were presented through combinations of textual, visual, and auditory information (Belda-Medina and Marrahi-Gómez, 2023). Several studies also suggested that AR-based vocabulary instruction may help increase learner attention and participation during classroom activities. In many cases, vocabulary learning was integrated into exploratory or interactive tasks that encouraged learners to engage more actively with the target language.

The reviewed studies additionally showed that AR-assisted vocabulary learning has been implemented across a wide range of educational contexts, including primary education, secondary education, higher education, and early childhood settings (Blanco and Conde, 2024; Topu et al., 2024). Some interventions also explored the use of AR with learners requiring multimodal or adaptive support, including students with specific educational needs (Shemy et al., 2024).

At the same time, the literature revealed important differences regarding the consistency and scope of these reported gains. While immediate vocabulary recognition and short-term recall were commonly assessed, considerably fewer studies examined delayed retention or the transferability of lexical knowledge beyond the intervention itself. Similarly, intervention duration varied substantially across studies, making direct comparison more difficult.

Overall, the reviewed evidence suggests that vocabulary acquisition represents the most consolidated area of AR-assisted language learning research between 2020 and 2025. Across different educational contexts and implementation models, AR-based vocabulary interventions consistently reported positive short-term outcomes, particularly in relation to lexical recognition, learner engagement, and multimodal vocabulary exposure.

3.3.2 Communicative skills and broader competence

Compared to the relatively consistent findings reported for vocabulary acquisition, the impact of AR on broader communicative skills and overall language competence remained considerably more variable across the analysed studies. Several investigations explored the potential of AR to support speaking, pronunciation, interaction, and communicative participation, although the reported outcomes were less consistent than those associated with lexical development.

Some interventions reported positive effects on oral participation, learner confidence, and willingness to communicate in the target language, particularly in activities involving role-play, collaborative interaction, or task-based communication (Liu et al., 2023; Ribeiro et al., 2024; Voreopoulou et al., 2024). In these contexts, immersive learning environments were frequently associated with more dynamic communicative interaction and increased learner participation during classroom activities. Several studies also examined AR within experiential or situated communicative scenarios. Learners were often required to exchange information, collaborate with peers, or negotiate meaning while interacting with augmented content integrated into physical or digitally enhanced environments. These activities were commonly described as more interactive and less artificial than more conventional classroom exercises.

At the same time, the reviewed findings concerning broader communicative competence remained comparatively mixed. While some studies reported improvements in speaking performance or communicative engagement, others identified only modest or statistically limited differences between AR-mediated instruction and more traditional instructional approaches. This variability was especially visible in relation to more complex linguistic dimensions such as pragmatic competence, oral fluency, or communicative accuracy. Another recurrent characteristic of the reviewed literature was the predominance of short-duration interventions focused

mainly on immediate classroom performance. As a result, evidence regarding the long-term development of communicative competence remained comparatively limited across the analysed studies.

In sum, the reviewed evidence suggests that AR has increasingly been associated with interaction-oriented and communicative learning activities between 2020 and 2025. However, compared to vocabulary-focused interventions, findings related to broader communicative development remain more heterogeneous and less conclusive across different educational contexts and implementation models.

3.3.3 Retention and transfer limitations

Despite the generally positive findings associated with AR-assisted language learning, the reviewed literature provided comparatively limited evidence regarding long-term retention and transferability of learning outcomes. Most studies focused primarily on immediate performance gains measured through post-intervention assessments conducted shortly after the instructional period.

One of the most recurrent patterns across the analysed studies was the predominance of short-duration interventions. Many AR-based activities were implemented over relatively brief periods ranging from a single classroom session to a few weeks, limiting the possibility of examining sustained language development or long-term retention processes (Schorr et al., 2024; Tran et al., 2024). This limitation became particularly visible in vocabulary-focused interventions. Although several studies reported improvements in immediate recall and recognition, comparatively fewer investigations incorporated delayed post-tests or longitudinal follow-up measures capable of evaluating whether vocabulary gains were maintained over time.

Similarly, evidence regarding transferability to broader communicative contexts remained limited. In many cases, learners demonstrated successful task performance within immersive classroom activities, yet fewer studies examined whether these outcomes extended beyond the immediate learning environment or contributed to sustained communicative competence. The reviewed literature also showed considerable variation in intervention duration, assessment procedures, and outcome measures, which complicated direct comparison across studies. In addition, relatively few investigations explicitly explored long-term language development or analysed learning trajectories beyond short-term instructional settings.

Overall, the reviewed findings indicate that recent research on AR-assisted language learning has primarily focused on immediate classroom outcomes rather than on longitudinal evidence of retention and transferability. While short-term gains are frequently reported across the literature, evidence concerning sustained language development remains comparatively limited and methodologically uneven.

This limitation becomes important for the interpretative model developed later in the paper, as it suggests that immediate engagement with AR environments should be distinguished from sustained linguistic retention and transfer.

3.4 Affective and Engagement-Related Outcomes

One of the clearest patterns identified across the reviewed studies concerns the positive influence of AR on affective dimensions of language learning, particularly learner motivation, engagement, participation, and classroom involvement (Belda-Medina and Marrahi-Gómez, 2023; Liao et al., 2024; Liu et al., 2023). Across different educational levels and implementation models, immersive learning activities were frequently perceived as more dynamic and stimulating than more conventional instructional approaches.

Several studies associated AR environments with increased learner attention and sustained participation during classroom tasks. The combination of visual, auditory, and interactive elements within physical learning spaces appeared to encourage more active involvement and greater behavioural engagement throughout the learning process. Positive affective responses were reported across different forms of implementation, including vocabulary-focused applications, game-based activities, and situated experiential tasks. Learners often described these experiences as more engaging, interactive, and participatory than traditional classroom exercises, particularly when collaborative or exploratory activities were involved.

Some studies also reported reductions in learner anxiety and increased willingness to communicate during immersive classroom activities, especially in role-play or task-oriented environments (Wedyan et al., 2022). In addition, interventions incorporating cultural or environment-based elements occasionally linked AR use to higher levels of intercultural interest and contextual engagement (Liu et al., 2023; Palzer et al., 2024; Ribeiro et al., 2024). At the same time, the reviewed literature showed that positive affective responses did not always correspond to stronger linguistic outcomes. Although learner motivation and participation were reported consistently across many studies, comparatively fewer investigations provided evidence of deeper linguistic processing, delayed retention, or sustained communicative development over time.

These recurrent tensions between affective engagement and variable linguistic outcomes later inform the Conditional Affordance Model proposed in Section 4.3, particularly regarding the relationship between immersive participation, instructional mediation, and cognitive processing demands. This distinction becomes important because many studies relied heavily on perception-based measures such as enjoyment, satisfaction, or motivation when evaluating AR interventions. While these dimensions offer valuable insight into learner experience, they provide more limited evidence regarding long-term educational effectiveness when they are not accompanied by broader measures of language development.

As a whole, the reviewed evidence suggests that affective and motivational outcomes represent one of the most stable findings within recent AR-assisted language learning research. Across diverse educational settings and implementation models, AR consistently appears capable of increasing learner engagement and classroom participation, even when broader linguistic outcomes remain more variable.

3.5 Methodological and Instructional Constraints

Alongside the positive outcomes frequently reported across the literature, the reviewed studies also revealed several recurrent methodological and instructional limitations. These limitations appeared across different implementation models and educational settings, suggesting that current research on AR-assisted language learning still remains methodologically uneven and difficult to compare directly (Schorr et al., 2024; Tran et al., 2024).

One of the most visible characteristics of the analysed studies was the predominance of short-term interventions and relatively small participant samples. Many investigations examined immersive learning activities over limited instructional periods, often ranging from a single classroom session to a few weeks. As a result, much of the existing evidence focuses primarily on immediate classroom performance rather than on sustained language development over time.

Considerable variation was also observed in research design, assessment procedures, technological tools, and targeted language skills. Quantitative, qualitative, and mixed-methods approaches were all represented across the corpus, although quasi-experimental designs and learner perception questionnaires were particularly common. This methodological diversity makes direct comparison between studies more difficult and limits the development of more consistent evidence regarding AR-related learning outcomes.

Another recurrent issue concerns the widespread use of self-reported measures of motivation, satisfaction, and learner perception as indicators of effectiveness. Although these dimensions provide valuable insight into learner experience, comparatively fewer studies incorporated validated measures of communicative competence, delayed retention, or broader language development.

From an instructional perspective, the reviewed studies also showed important differences in the extent to which AR activities were connected to clear linguistic or communicative objectives. In some interventions, AR functioned mainly as a visual or interactive supplement, whereas other studies integrated immersive activities into more structured communicative or task-based learning sequences (Gil Parga et al., 2024).

These differences in instructional organisation provide one of the central analytical bases for the Conditional Affordance Model, since they suggest that AR affordances become educationally meaningful only when mediated through coherent pedagogical design.

The literature additionally revealed substantial variation in the technological complexity and instructional organisation of AR implementations. Some studies relied on relatively simple mobile-based applications, while others incorporated more elaborate multimodal or location-sensitive environments requiring greater levels of classroom coordination and technological management. Several investigations also identified limitations related to AR authoring tools and educational platforms. Recent studies suggest that some available tools prioritise technical functionality and visual interaction while offering comparatively limited support for lesson planning, curriculum integration, or instructional organisation (Silva et al., 2024).

To conclude, these findings indicate that the current evidence base surrounding AR-assisted language learning remains both methodologically and instructionally heterogeneous. Although the reviewed literature reflects growing interest in immersive language learning environments, considerable variation continues to exist regarding research design, implementation conditions, and outcome evaluation procedures.

3.6 Contextual and Structural Factors

Beyond methodological considerations, the reviewed literature also identified several contextual and structural factors influencing the implementation of AR within language learning environments. These factors were mainly related to teacher preparation, technological infrastructure, institutional support, and differences in access to digital resources across educational settings.

One of the most recurrent themes across the analysed studies concerns teacher readiness and professional preparation for AR integration. Several investigations reported that educators generally perceived AR as an innovative and potentially motivating educational tool, while simultaneously identifying difficulties related to classroom implementation, technological management, and lesson organisation (Wedyan et al., 2022). In many cases, teachers highlighted limited training opportunities and insufficient preparation time as important barriers to the effective integration of immersive learning activities. Recent studies examining professional development in digital education also suggest that technology-related training often prioritises technical operation over classroom application or curriculum integration (Mena et al., 2023).

Another recurrent factor involved the availability of technological infrastructure and digital resources. Although many interventions relied on smartphones or tablet-based applications, the reviewed studies revealed substantial differences in device accessibility, internet connectivity, and institutional technological support across educational contexts. Several investigations also pointed to challenges associated with maintaining stable technological conditions during classroom implementation. Issues related to software compatibility, connectivity problems, device performance, and classroom logistics were repeatedly identified as factors affecting the continuity of technology-mediated learning activities.

The reviewed literature further suggests that most studies on AR-assisted language learning have been conducted within relatively favourable educational contexts characterised by access to technological infrastructure and institutional support. In contrast, comparatively fewer investigations examined AR implementation in under-resourced environments or in settings affected by limited digital accessibility. Another visible pattern concerns the organisational demands associated with AR integration. Some studies reported that immersive classroom activities required additional preparation, technological coordination, and adaptation of learning spaces, particularly in interventions involving collaborative or location-sensitive interaction. A smaller number of studies also identified emerging concerns related to ethical and sustainability issues surrounding immersive educational technologies, including data privacy, technological dependence, and equitable access to digital learning opportunities. Although these topics remain comparatively underexplored within the analysed literature, they appear increasingly present in recent discussions surrounding AR in education.

Overall, the reviewed studies demonstrate that the implementation of AR in language learning is shaped not only by instructional design and technological affordances, but also by broader structural and institutional conditions. Across the analysed literature, factors such as teacher preparation, infrastructure availability, institutional support, and digital accessibility consistently influenced the feasibility and organisation of immersive learning environments. These contextual conditions are therefore treated in the model not as peripheral implementation issues, but as factors that shape how AR affordances can be activated, sustained, or constrained within real educational settings.

4. Discussion

4.1 Augmented Reality as an Affective Catalyst

One of the most consistent patterns identified across the reviewed literature concerns the relationship between Augmented Reality and affective engagement within language learning environments. Across different educational contexts and implementation models, AR-supported activities were frequently associated with higher levels of learner motivation, participation, attention, and classroom involvement than more conventional instructional approaches. Similar tendencies have also been identified in previous reviews examining immersive educational technologies within CALL and broader technology-enhanced learning research (Akçayır and Akçayır, 2017; Cai et al., 2022; Shadiev and Liang, 2023).

This tendency appears closely connected to the multimodal and interactive nature of AR environments. By combining visual, spatial, auditory, and contextual elements within communicative activities, AR frequently generates learning experiences perceived as more participatory and experientially rich than conventional classroom interaction. Several studies reported that learners became more actively involved in classroom tasks when language activities incorporated exploratory dynamics, collaborative interaction, or situated forms of participation. In this sense, AR seems particularly effective at intensifying behavioural engagement and increasing willingness to interact within the learning environment.

At the same time, the reviewed findings reveal an important distinction between affective engagement and sustained linguistic development. While motivation, participation, and learner involvement appeared consistently across many interventions, evidence concerning communicative competence, long-term retention, and broader language acquisition remained considerably more uneven. Increased participation therefore should not be interpreted automatically as evidence of deeper linguistic processing.

This distinction becomes especially relevant when considering the methodological tendencies identified across the reviewed studies. A substantial part of the literature continues to evaluate AR-supported learning primarily through learner perception

measures such as enjoyment, satisfaction, or motivation. Although these dimensions provide valuable insight into learner experience, they offer more limited evidence regarding educational effectiveness when they are not accompanied by broader measures of communicative performance or delayed language development.

The reviewed literature therefore suggests that AR functions most consistently as an affective catalyst within language learning environments. Its capacity to increase learner attention and classroom participation appears relatively well established across different implementation models and educational settings. The central issue is not whether AR captures learner interest, but under which pedagogical and cognitive conditions this engagement contributes to sustained communicative development and meaningful language learning.

4.2 The Pedagogical Conditionality of AR

The distinction identified in the previous section between affective engagement and sustained linguistic development becomes central when examining the pedagogical role of AR within language learning environments. Although immersive activities frequently increased learner motivation, participation, and classroom involvement, the reviewed studies consistently showed that these positive affective responses did not necessarily translate into equivalent language gains. This variability suggests that the educational significance of AR cannot be explained through technological features alone, but through the pedagogical conditions under which immersive interaction is organised.

Across the reviewed corpus, studies reporting stronger linguistic outcomes were generally characterised by clearly defined communicative objectives, structured task sequences, and sustained opportunities for meaningful language use. By contrast, interventions in which AR functioned primarily as a visual enhancement tool or as an isolated technological supplement frequently produced weaker or less consistent outcomes, even when learner engagement remained high. Similar conclusions have also been identified in recent reviews examining AR integration within technology-enhanced language learning environments (Gil Parga et al., 2024; Tran et al., 2024).

This distinction points to a broader tension within current AR-assisted language learning research. Immersive environments may intensify learner participation and create more dynamic forms of classroom interaction, yet these affordances do not inherently generate deeper linguistic processing. The reviewed literature instead suggests that AR becomes educationally meaningful when immersive features are integrated into coherent communicative learning structures capable of directing learner attention towards language use rather than towards technological interaction itself. In this sense, the pedagogical organisation of the activity appears considerably more influential than the technological complexity of the AR environment alone.

Several studies associated stronger outcomes with activities requiring learners to negotiate meaning, collaborate with peers, solve situated problems, or engage in sustained communicative interaction. These interventions typically positioned AR as part of broader task-based or experiential learning sequences rather than as a standalone technological resource. This interpretation aligns with wider developments in CALL research, where digital technologies are increasingly understood as mediational tools embedded within socially and educationally situated learning processes rather than as autonomous instructional solutions (Hubbard, 2014; Rahman, 2025).

The reviewed findings also highlight the importance of instructional guidance within immersive learning environments. Teacher facilitation, classroom sequencing, and communicative scaffolding frequently appeared as central factors shaping how learners interacted with augmented content. Without sufficient pedagogical mediation, highly interactive environments may intensify behavioural participation while simultaneously generating competing attentional demands that reduce focus on linguistic processing and communicative development.

Viewed from this perspective, the educational value of AR emerges through the relationship between technological affordances, instructional organisation, and learner interaction rather than through immersion alone. The variability identified across the reviewed studies therefore appears less contradictory when interpreted as the result of different pedagogical conditions, communicative demands, and implementation structures surrounding AR-supported language learning activities.

4.3 Reinterpreting AR through the Conditional Affordance Model

The patterns identified across the reviewed literature point to the need for a more theoretically grounded interpretation of AR-assisted language learning. While previous research has extensively documented the motivational and interactive potential of immersive environments, comparatively less attention has been devoted to explaining why linguistic outcomes appear uneven across educational settings and implementation models. In response to this limitation, the present study proposes the Conditional Affordance Model of AR in Language Learning as a framework for interpreting this variability beyond technologically deterministic perspectives.

Rather than treating AR as a technology with fixed educational effects, the model conceptualises immersive language learning as a context-sensitive process shaped by the interaction between technological affordances, instructional organisation, situated participation, and cognitive regulation. From this perspective, the educational significance of AR does not emerge automatically from immersion itself, but from the ways immersive features are integrated into communicative activity and pedagogical practice.

The model draws primarily on Affordance Theory, particularly Gibson's (1979) understanding of affordances as action possibilities emerging through the relationship between individuals and their environments. Applied to AR-assisted language learning, this perspective suggests that features commonly associated with AR, such as multimodality, interactivity, spatial integration, and contextualisation, do not inherently produce language development. Instead, they create conditions that may facilitate different forms of participation, communication, and attentional engagement depending on how immersive activities are pedagogically organised.

This interpretation also connects with Norman's (1988) notion of perceived affordances, which emphasises that learners interact not simply with technological features themselves, but with how those features are interpreted and operationalised within particular instructional contexts. Consequently, the same AR environment may generate substantially different forms of learner interaction depending on communicative demands, classroom organisation, and task sequencing.

The reviewed findings additionally resonate with Situated Learning Theory (Lave and Wenger, 1991), particularly in relation to collaborative participation and environment-based interaction. Several studies associated stronger outcomes with AR activities involving contextualised communication, collaborative problem-solving, and experiential language use embedded within physically or socially situated environments (Parlar and Sütçü, 2025; Ribeiro et al., 2024). These conditions appear especially relevant for understanding why immersive learning activities frequently generate strong affective and participatory responses across different educational settings.

At the same time, situated participation alone may not fully explain the variability observed across linguistic outcomes. To account for these inconsistencies, Cognitive Load Theory (Sweller, 1988) offers an additional perspective focused on attentional processing and cognitive resource allocation during multimodal learning tasks. Highly immersive environments frequently require learners to process linguistic input simultaneously with visual stimuli, spatial information, interactive navigation, and task-related decision-making. Although these features may intensify behavioural engagement, they may also generate competing attentional demands that reduce sustained linguistic processing when communicative tasks lack sufficient instructional structure. Earlier reviews examining AR in education similarly identified risks associated with divided attention, excessive multimodal stimulation, and fragmented attentional focus within visually dense learning environments (Akçayır and Akçayır, 2017; Wu et al., 2013).

From this perspective, differences in learning outcomes appear closely connected to the extent to which immersive environments balance interactional richness with cognitively manageable learning conditions. Under limited instructional guidance, learners may become highly involved in technological interaction while allocating comparatively less attention to communicative processing and language development.

4.3.1 Components of the Conditional Affordance Model

The Conditional Affordance Model conceptualises AR-assisted language learning as the result of interactions between multiple pedagogical, cognitive, and contextual dimensions rather than as the direct consequence of technological immersion alone. The model is organised around five interconnected components that collectively shape the educational role of AR within language learning environments.

The first component, technological affordances, refers to the multimodal, interactive, and spatial features commonly associated with AR environments, including contextualisation, visual augmentation, real-time feedback, and situated interaction. These affordances create possibilities for learner engagement and experiential participation, although their educational value appears closely dependent on how they are integrated into instructional practice.

The second component, instructional mediation, concerns the pedagogical organisation of AR-supported activities, including communicative task design, sequencing of learning activities, teacher facilitation, classroom guidance, and alignment between technological interaction and linguistic objectives. Across the reviewed studies, stronger learning outcomes tended to emerge when immersive activities formed part of structured communicative or task-based instructional sequences.

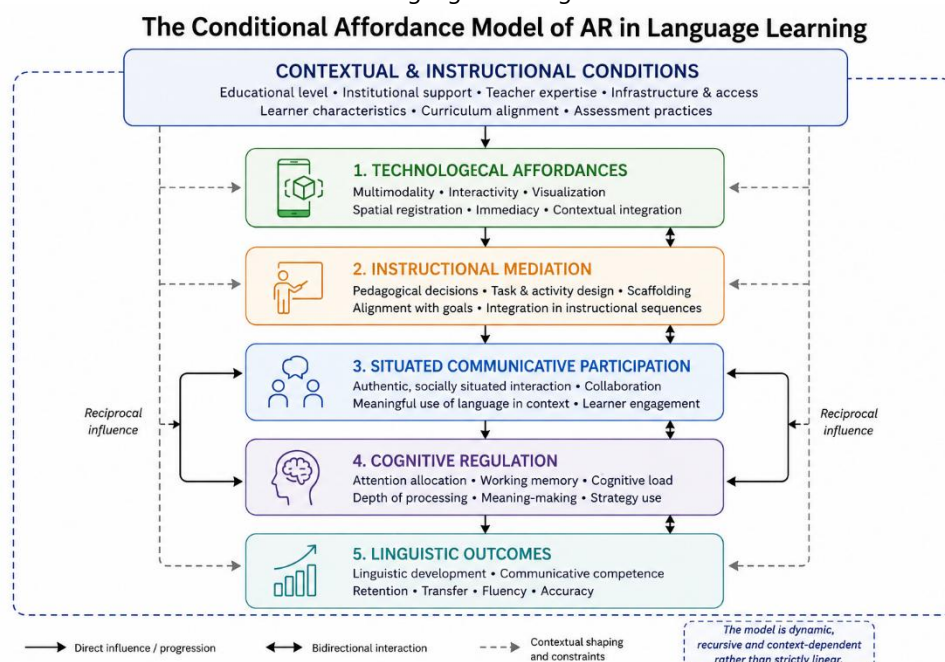
The third component, situated communicative participation, refers to the extent to which learners engage in collaborative, contextualised, and environment-based interaction while using the target language. Drawing on Situated Learning Theory, the

model assumes that language learning may become more meaningful when communication is embedded within socially and physically situated activity rather than isolated technological interaction.

The fourth component, cognitive regulation, refers to the allocation of attentional and processing resources during immersive learning activities. AR environments frequently combine linguistic input with visual, spatial, and interactive stimuli, potentially generating competing cognitive demands. Learning outcomes therefore appear partly dependent on the extent to which immersive interaction remains cognitively manageable and supports sustained linguistic processing rather than attentional fragmentation.

The final component, linguistic outcomes, represents the emergent dimension of the model and includes vocabulary acquisition, communicative participation, retention, interactional competence, and broader language development. The reviewed literature suggests that these outcomes remain variable because they emerge through the interaction between technological affordances, instructional mediation, situated participation, and cognitive regulation rather than through immersion alone.

Figure 1. The Conditional Affordance Model of AR in Language Learning



Note. The model illustrates the dynamic relationships between technological affordances, instructional mediation, situated communicative participation, cognitive regulation, and linguistic outcomes within AR-assisted language learning environments.

Importantly, the relationships represented in the model are dynamic rather than strictly sequential. Technological affordances may facilitate situated communicative participation, but their educational value remains mediated by instructional organisation and constrained by cognitive regulation processes. Consequently, linguistic outcomes appear to emerge through the interaction between immersive affordances, pedagogical mediation, contextual conditions, and learner processing demands rather than through technological immersion alone.

The Conditional Affordance Model therefore positions AR less as an inherently transformative educational technology and more as a pedagogically conditional learning environment whose educational significance may emerge differently across instructional and implementation contexts. From this perspective, the inconsistencies identified across the reviewed literature appear less contradictory when interpreted as the result of different relationships between immersive affordances, communicative activity, instructional organisation, and cognitive processing demands.

4.4 Structural Inequality and the Limits of Technological Optimism

Beyond pedagogical considerations, the reviewed literature demonstrates that the implementation of AR-assisted language learning remains strongly conditioned by broader institutional, infrastructural, and socioeconomic realities. This perspective complicates technologically optimistic narratives that frequently present immersive educational technologies as universally accessible, easily scalable, or transferable across educational settings regardless of contextual differences.

One of the clearest patterns identified across the analysed studies concerns the relationship between technological innovation and institutional capacity. Successful AR implementation frequently depended on access to stable digital infrastructure, compatible devices, institutional support, and sufficient preparation time for both teachers and learners. As a result, many of the interventions reporting positive outcomes were conducted within comparatively favourable educational environments characterised by consistent access to technological resources and structured support systems.

By contrast, substantially less attention was devoted to under-resourced educational contexts affected by infrastructural instability, limited connectivity, or unequal access to digital technologies. This imbalance raises important concerns regarding the broader transferability of current findings. In many cases, the educational effectiveness attributed to AR may reflect the presence of supportive institutional conditions rather than the technological intervention alone.

The reviewed studies also highlight the central role of teacher preparation in shaping the feasibility and long-term sustainability of immersive learning environments. Although educators frequently perceived AR as motivating and pedagogically valuable, several investigations reported difficulties associated with classroom coordination, technological management, lesson adaptation, and instructional sequencing. Immersive technologies therefore appear to increase the organisational complexity of teaching rather than simplify it. Similar concerns have been identified in recent research examining AR integration and teacher professional development (Mena et al., 2023; Wedyan et al., 2022).

These challenges become particularly visible in relation to teacher training. Several studies suggest that technology-oriented professional development programmes continue to prioritise operational or technical competencies while dedicating comparatively less attention to pedagogical adaptation, communicative task design, and curriculum integration. Consequently, teachers may become familiar with AR tools without necessarily developing the instructional expertise required to integrate them meaningfully into language learning processes.

The reviewed literature additionally suggests that technological enthusiasm occasionally obscures the organisational and logistical demands associated with immersive learning environments. AR implementation frequently requires additional preparation time, technological maintenance, classroom adaptation, and continuous instructional coordination. When institutional support structures remain limited or inconsistent, these demands may reduce the long-term sustainability of AR-supported interventions despite their short-term motivational benefits.

From this perspective, the educational value of AR cannot be understood exclusively through technological affordances or instructional innovation alone. Access to immersive learning opportunities remains unevenly distributed across institutions, regions, and learner populations, meaning that the potential benefits associated with AR integration continue to depend heavily on broader socioeconomic and infrastructural conditions.

The reviewed findings therefore reinforce the need for more context-sensitive approaches to immersive language learning research. The future development of AR-assisted language learning depends not only on technological innovation, but also on the capacity of educational institutions to create sustainable pedagogical, organisational, and infrastructural conditions capable of supporting meaningful implementation over time.

4.5 Implications for Research and Pedagogical Practice

The findings of this review have several implications for future research and pedagogical practice within AR-assisted language learning. From a research perspective, the reviewed literature demonstrates the need for more methodologically robust and theoretically grounded studies. Much of the existing research continues to focus on short-term interventions and perception-based outcomes, particularly motivation and learner satisfaction. As a result, there is still limited evidence regarding sustained language development and long-term communicative gains. Similar limitations have also been identified in recent systematic reviews examining AR within technology-enhanced language learning environments (Shadiev and Liang, 2023; Tran et al., 2024).

In particular, future research would benefit from prioritising longitudinal designs, validated measures of communicative competence, and greater methodological transparency regarding instructional conditions, technological configurations, and implementation procedures. Greater attention should also be devoted to underexplored areas such as pragmatic development, long-term transferability, and the implementation of AR within diverse or under-resourced educational contexts.

The reviewed findings additionally suggest the importance of moving beyond technologically deterministic frameworks when evaluating immersive educational technologies. Rather than focusing primarily on technological novelty or learner perception, future studies should examine more explicitly how immersive environments interact with instructional organisation, contextual variables, and cognitive processes during language learning activities.

From a pedagogical perspective, the reviewed literature reinforces the importance of aligning technology-mediated activities with clearly defined communicative and linguistic objectives. Across the analysed studies, the educational effectiveness of AR appeared to depend less on technological sophistication itself than on the quality of instructional organisation and the extent to which learners engaged in meaningful language use.

The findings also highlight the central role of teachers within immersive learning environments. Effective implementation requires not only technical familiarity with AR tools, but also the instructional expertise necessary to integrate technological affordances into coherent communicative and task-based learning sequences. Consequently, teacher education and professional development programmes should place greater emphasis on pedagogically oriented digital training rather than exclusively technical instruction. Recent research examining AR authoring tools and teacher preparation similarly suggests that pedagogical guidance remains considerably less developed than technical functionality within many educational platforms (Silva et al., 2024).

Finally, the reviewed evidence suggests that the future development of AR-assisted language learning should be approached with both pedagogical ambition and critical caution. Although AR offers considerable potential for creating engaging and contextually enriched learning experiences, its educational value ultimately depends on whether these experiences are connected to clear communicative objectives, manageable task demands, and sustainable instructional conditions.

5. Conclusion

This study has provided a structured critical review of recent research on Augmented Reality (AR) within language learning environments published between 2020 and 2025. The reviewed literature reflects the growing presence of immersive technologies within CALL and technology-enhanced language education, particularly through the expansion of mobile, interactive, and environment-based learning practices. Across different implementation models and educational contexts, AR frequently appeared associated with increased learner motivation, classroom participation, and affective engagement during language learning activities.

At the same time, the findings reviewed throughout the study revealed a considerably more uneven picture regarding sustained linguistic development. Although many interventions reported positive motivational and participatory outcomes, evidence concerning communicative competence, long-term retention, pragmatic development, and broader language acquisition remained substantially more variable across studies. This variability emerged as one of the central analytical tensions within the literature and suggests that immersive engagement alone may provide an insufficient explanation for language learning effectiveness.

The analysis conducted throughout this review further indicates that the educational role of AR appears shaped less by technological novelty itself than by the pedagogical and cognitive conditions under which immersive interaction is organised. Studies reporting stronger outcomes were generally associated with clearer communicative objectives, structured task-based activities, sustained opportunities for meaningful language use, and stronger forms of instructional guidance. Conversely, interventions in which AR functioned primarily as a visual or motivational supplement frequently appeared to produce less consistent linguistic results despite generating high levels of learner participation.

In response to these patterns, the study proposed the Conditional Affordance Model of AR in Language Learning as a framework for interpreting the variability identified across the reviewed literature. Drawing on Affordance Theory, Situated Learning Theory, and Cognitive Load Theory, the model conceptualises AR-assisted language learning as a dynamic interaction between technological affordances, instructional mediation, situated communicative participation, and cognitive regulation processes. From this perspective, immersive technologies may be understood less as inherently transformative educational tools and more as pedagogically conditional learning environments whose educational significance emerges differently across instructional and contextual conditions.

The review also identified important structural limitations affecting the current development of the field. Unequal access to technological infrastructure, institutional support, teacher preparation, and sustainable implementation conditions continues to shape the feasibility of AR integration across educational settings. In addition, the predominance of short-term interventions and perception-based evaluation measures appears to limit the long-term interpretability and comparability of existing findings. Future research would likely benefit from more longitudinal and theoretically grounded investigations capable of examining how immersive learning environments influence communicative development, attentional processing, and situated language use over extended periods of instruction. Greater attention could also be devoted to underexplored educational contexts, particularly under-resourced environments and learner populations that remain comparatively underrepresented within current AR-assisted language learning research.

Ultimately, the findings of this review suggest that the future relevance of AR in language education may depend less on technological sophistication alone than on the development of pedagogically coherent and context-sensitive learning environments capable of supporting meaningful communicative activity over time. Advancing the field therefore appears to require stronger theoretical integration, more sustainable implementation models, and a clearer understanding of how immersive technologies interact with the educational realities in which language learning takes place.

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