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Designing a web-based multisensory learning framework for teaching English

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ABSTRACT

This study aims to design a web-based multisensory learning framework for English language teaching and to examine its perceived impacts on learners' engagement and retention. Utilizing a structured four-stage Critical Literature Review (CLR) methodology, this research synthesizes peer-reviewed literature published between 2015 and 2025 across multisensory instruction, Cognitive Load Theory, computer-assisted language learning (CALL), and sociocultural dimensions. Findings reveal that an effective web-based framework requires five core pillars: multisensory engagement, emotional and motivational support, multimedia-technology integration, learner personalization, and social scaffolding. Synchronized integration of these pillars mitigates cognitive friction, enhances schema formation, and strengthens long-term memory retention. Implementation of the framework yields seven primary learner impacts, including heightened intrinsic motivation, expanded attention span, increased self-confidence, and reduced language anxiety. This study provides a comprehensive conceptual model and implementation insights to guide educators, software developers, and institutions in engineering adaptive, inclusive, and cognitively optimized web-based English learning environments.

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1. INTRODUCTION

The development of digital technology has changed the way students learn languages, especially through Web-Based Learning (WBL), which offers flexibility, interactivity, and multimedia integration as part of the English language learning process. WBL allows students to access materials anytime and anywhere, with interactive features that involve various forms of media such as images, videos, and audio (Khan, 1997, 1999; Chapelle, 2001). Previous studies have shown that web platforms can improve receptive skills, such as listening comprehension, from 71.75 to 83.52 through multimedia-based activities (Nurohmawati &

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Arini, 2023). However, the success of web-based learning is greatly influenced by the quality of the learning design and the ability of the system to respond to diverse learning needs.

One of the biggest challenges in digital learning is how to create a learning experience that is both engaging and effective for students with different learning styles. The multisensory approach offers an answer to this challenge. Through a combination of visual, auditory, and kinesthetic senses, multisensory learning helps strengthen long-term memory and increase learning engagement (Rompas & Recard, 2021; Vena & Yuliana, 2023). Other findings indicate that the multisensory use of picture cards, videos, and body movements has been proven to improve vocabulary mastery and retention (Algrni, 2020). The integration of technology further strengthens these benefits through features such as pronunciation analysis, sound wave visualization, and real-time feedback that can improve students' accuracy and attention (Wu & Tai, 2016).

Beyond cognitive aspects, affective and social aspects also play a crucial role in language learning success. A multisensory approach has been shown to increase students' intrinsic motivation, self-confidence, and positive emotional responses (Sahlan, 2022; Gazioğlu & Karakuş, 2023). This emotional involvement is further strengthened when multisensory learning is combined with social scaffolding from teachers, parents, or peers, both in the classroom and in online learning (Mason et al., 2019; Rompas & Recard, 2021). The study confirms that social interaction helps students interpret multisensory stimuli more meaningfully.

However, despite its great potential, studies integrating WBL and multisensory approaches within a single learning design framework remain limited. Most research addresses WBL or multisensory approaches separately, thus failing to provide systematic guidance on how both can be designed in an integrated manner. This gap is the urgency of this study, especially amid the need for adaptive, personalized, and student-centered digital learning. In line with this, limitations in infrastructure, teacher readiness, and the risk of cognitive load due to inappropriate multimodal design add to the complexity of web-based learning development (Suryaratri et al., 2019; Sweller, 2018).

Based on this context, this study formulates two main questions: (1) How to design an effective web-based multisensory learning framework to improve English language acquisition? and (2) What are the impacts felt by students in the application of this framework on learning engagement and retention? This problem formulation leads to the research objective, which is to design a comprehensive web-based multisensory learning framework and analyze the impact of its implementation on student engagement and retention.

This study offers an important scientific contribution by filling the literature gap on the integration of multisensory approaches in the context of WBL for English language learning. By combining multisensory principles, cognitive load theory, multimedia learning, and affective and social aspects, this study provides a more complete and practice-oriented conceptual model. Furthermore, this study provides implications for digital content developers, educators, and researchers in designing learning media that is more responsive, adaptive, and centered on a holistic learning experience.

2. METHODS

This study uses a qualitative approach with the Critical Literature Review (CLR) method to evaluate learning strategies, assessment practices, and implementation challenges in developing a web-based multisensory learning framework for English language teaching. The research object is a corpus of academic literature that was purposively selected based on its relevance to the topics of multisensory, web-based learning, and English language teaching, with publications limited to the period between 2015 and 2025. Data were collected through

document analysis of journal articles, proceedings, and book chapters that met the inclusion criteria, namely sources that were peer-reviewed, focused on multisensory and/or web-based learning, and provided empirical findings and learning design concepts. The search process was conducted through Google Scholar, ERIC, Scopus, and ScienceDirect using keywords such as multisensory learning, web-based learning, and conceptual framework. To ensure analytical rigor and systematic selection, the corpus retrieval process followed a four-stage evaluation procedure:

2.1.Identification Phase

Broad search queries across scholarly databases generated an initial repository of literature focused on computer-assisted language learning (CALL), technology-enhanced multisensory instruction, and multimedia learning theory.

2.2.Screening Phase

Titles and abstracts were screened against initial boundary criteria. Non-peer-reviewed materials, works published prior to 2015, duplicate entries, and non-English studies were removed.

2.3.Eligibility Assessment

Full-text manuscripts were assessed to ensure they provided substantive empirical data, instructional design frameworks, or theoretical evaluations regarding visual, auditory, or kinesthetic integration in web environments.

2.4.Inclusion & Synthesis

The finalized dataset was categorized using reference management tools, ensuring valid thematic categorization during open and axial coding.

The collected literature was analyzed using thematic content analysis. Through open coding and axial coding, primary patterns, theoretical interactions, and instructional gaps were categorized into pedagogical principles, technology-sensory integration mechanisms, and digital delivery challenges. This analytical structure informed the synthesis of the conceptual framework and its broader pedagogical implications for English as a Foreign Language (EFL) instruction.

3. RESULTS AND DISCUSSION

This section presents the key findings of the Critical Literature Review (CLR) on web-based multisensory learning for English language acquisition. The results are interpreted by synthesizing recurring themes from empirical and conceptual studies, focusing on how web-based multisensory principles enhance learner engagement and retention, and how these findings inform the design of the proposed Web-Based Multisensory Learning Framework (WBM-LF) in this study. Based on the literature, an effective framework must include five core design components:

3.1. Web-Based Multisensory Learning Framework

To bridge conceptual design principles with concrete web development execution, Table 1 delineates the mapping between the five core framework pillars, primary web-based interactive mechanisms, and targeted pedagogical outcomes.

Table 1. Framework Component Alignment Matrix

Core MSL Pillar	Web Technology Mechanism	Targeted Pedagogical & Cognitive Outcomes
Multisensory Engagement	Interactive audio visualizers, tactile drag-and-drop mechanics, synchronized subtitles, color-coded syntax highlights.	Dual-channel memory activation, reduced split-attention, deeper schema construction.
Emotional & Motivational Support	Gamified progression pathways, interactive avatar feedback, adaptive sound effects, storytelling mechanics.	Lowered affective filter, heightened learning persistence, reduced speaking anxiety.
Multimedia & Web Integration	Speech waveform visualizers, real-time audio comparison, streamlined navigation interface.	Enhanced phonological awareness, minimized extraneous cognitive load, targeted focus via signaling.
Learner Personalization	Playback rate controllers, modality toggle switches (visual/auditory mode), private recording vaults.	Elevated self-regulated learning, custom pacing, reduced peer pressure during oral practice.
Parental & Social Support	Learning analytics dashboards, peer collaboration spaces, teacher feedback widgets, parent monitoring prompts.	Guided stimulus interpretation, context-specific scaffolding, sustained home study motivation.

3.1.1. Multisensory Engagement & Cognitive Connection

Multisensory engagement enhances language comprehension because information enters through multiple sensory pathways, strengthening memory. Visual media (images, color-coding, gestures), auditory input (songs, narration, pronunciation models), and kinesthetic tasks (drag-and-drop, role-play, TPR) improve vocabulary recall, reading comprehension, and listening processing. This aligns with Mayer's Dual Channel assumption and Paivio's Dual Coding Theory, which emphasize balanced visual-verbal integration. Framework implication: Web-based tasks should combine text, visuals, sound, and movement-based interactions to foster deeper cognitive processing.

The results of the literature analysis show that multisensory engagement is a fundamental component in developing an effective Web-Based Multisensory Learning (MSL) framework. Learning experiences that activate more than one sensory modality—visual, auditory, and kinesthetic—have been consistently found to increase engagement, selective attention, and language processing abilities. Studies in the data corpus (e.g., Rompas & Recard, 2021; Vena & Yuliana, 2023) emphasize that the presence of images, colors, semantic icons,

model sounds, and kinesthetic responses provides additional “anchors” for the brain to manage and interpret linguistic input in a richer and more stable way.

Cognitively, multisensory integration strengthens the connection between visual and verbal channels as described in the Dual Coding Theory framework. When students receive information through two different representational channels, the likelihood of schema formation increases, facilitating recall, meaning elaboration, and linguistic task completion. These findings are reinforced by cognitive load theory (Sweller, 2018), which states that multisensory representations can reduce intrinsic load by providing additional explanations through other modalities, as long as the placement of media is consistent and relevant temporally and spatially.

Furthermore, cognitive connections through multisensory means do not only occur at the stage of recognizing words or phrases, but also in understanding more complex concepts. For example, when students learn the concepts of intonation and rhythm in English, visualizing sound waves and audio comparisons helps students develop a deeper phonological understanding (Wu & Tai, 2016). These results confirm that multisensory engagement functions as a catalyst that enriches mental processing pathways and improves language acquisition efficiency.

Academically, these sub-findings confirm that multisensory engagement is not merely a tool for attracting attention, but a neurocognitive foundation that strengthens language processing through multi-pathway activation in working memory and long-term memory.

3.1.2. Emotional & Motivational Engagement

In addition to cognitive aspects, multisensory elements have been proven to have a strong impact on students' emotional and motivational domains. This study show that animation, sound effects, interactive avatars, and storytelling, role-play, and impersonation activities can trigger positive responses such as curiosity, enthusiasm, and self-confidence. These emotional responses are very important in the context of learning a foreign language (EFL), where anxiety about speaking and fear of making mistakes often hinder student participation.

The literature supports these findings—for example, Gazioğlu & Karakuş (2023) found that multisensory stimuli can improve mood and increase emotional engagement during the learning process, which directly lowers the affective filter and opens up space for more effective language processing. Similarly, Sahlan's (2022) research showed a significant increase in confidence when students were given the opportunity to role-play with visual, audio, and body movement support, which helped them practice the language more naturally and expressively.

Multisensory learning also influences intrinsic motivation by providing an “immersive” learning experience that combines elements of gamification, exploration, and a sense of accomplishment through instant feedback. When students see their avatars react positively or hear success indicators, they are encouraged to repeat the task and improve their performance voluntarily. These elements form an affective feedback loop that reinforces persistence and engagement.

From an academic perspective, this subchapter expands the understanding that effective learning design works not only through cognitive components, but also through emotional processes that mediate attention, persistence, and language courage.

3.1.3. Multimedia & Web-Technology Integration

The findings also confirm that the quality of multimedia integration and web technology forms the operational foundation of the MSL framework. Web technology enables the presence

of dynamic elements such as audio recording tools, speech analysis systems, waveform visualizers, exploratory hyperlinks, and interactive simulations, all of which function as part of a multimodal feedback system. The study by Wu & Tai (2016) shows that web-based pronunciation analysis features can improve pronunciation accuracy by providing visualizations comparing students' voices with the original model, thereby creating a reflective and investigative learning experience.

However, the integration of technology in MSL cannot be done carelessly. The synthesized literature indicate that overly crowded interfaces, inconsistent color designs, or confusing web navigation can reduce the effectiveness of MSL by increasing extraneous cognitive load. Therefore, multimedia design principles such as coherence, signaling, and contiguity must be applied so that students can focus on essential information.

The analysis also highlights that technology must fulfill aspects of functionality (ease of use), accessibility (compatibility with various devices), and stability (minimal technical disruptions). Technical challenges such as unstable networks or audio latency have been shown to hinder multisensory processes that require precise synchronization between modalities.

Academically, this section emphasizes that MSL combines pedagogy and technology engineering. Thus, MSL framework design is not merely an activity of assembling media, but an instructional engineering process that requires technological quality and visual design that supports cognitive and affective processes.

3.1.4. Learner Personalization & Adaptability

Personalization and adaptivity emerged as one of the most significant elements in the findings. Web-based learning allows students to set their own learning pace through features such as pause, replay, learning path selection, speed settings, and choice of modality. This gives students the space to tailor their learning experience to their needs whether in terms of modality preferences, language proficiency levels, or tolerance for cognitive load.

According to Nosrati (2015), the adaptivity of digital learning plays an important role in increasing learning autonomy and providing opportunities for students to self-regulate their own learning strategies, especially in the context of multisensory learning that is rich in stimuli. The combination of self-control and multimodal feedback allows students to engage in a reflective learning cycle: trying, evaluating, and improving performance.

Findings also show that personalization can reduce anxiety and increase learning comfort. Students who are hesitant to practice pronunciation in front of the class can take advantage of the private voice recording feature, allowing them to practice repeatedly without social pressure. This personalization also facilitates differentiated learning, allowing visual, auditory, and kinesthetic learners to choose the learning path that suits them best.

From an academic perspective, these sub-findings expand the discussion on learner autonomy in the context of digital language learning and show that personalization is a core component of MSL, not just an additional feature.

3.1.5. Parental & Social Support Integration

The final subchapter shows that the success of MSL is not only supported by technology and media design, but also by the social environment involving teachers, peers, and parents. In the context of EFL, especially in web-based learning conducted at home, the role of parents becomes very important in helping students focus, providing guidance, and providing emotional support. Research by Gazioğlu & Karakuş (2023) shows that multisensory experiences are more effective when students receive social assistance in correctly interpreting visual and auditory stimuli.

Other findings (Mason et al., 2019) also confirm that social scaffolding increases students' awareness of task goals, refines their interpretation of multisensory stimuli, and strengthens motivation through social validation and positive reinforcement. Thus, multisensory learning experiences conducted without social support can reduce depth of understanding, as students may lose orientation or misinterpret stimuli.

From an academic perspective, these results underscore that the MSL framework is socially extended, not a solo-learning framework. Multisensory learning works most optimally when social interaction guides and confirms the meaning of the stimuli processed by students.

The five sub-findings confirm that the effectiveness of Web-Based Multisensory Learning does not only stem from the presence of various modalities, but from the harmony between aspects: sensory activation that strengthens cognitive processing, emotional and motivational stimulation, precise multimedia and web technology engineering, personalization and adaptability, as well as social support that underpins the process of interpretation and motivation.

3.2. Impacts of Implementing the Framework

3.2.1. Increased Retention

The data shows that multisensory learning strengthens retention through the dual encoding process, as information is processed simultaneously through visual, auditory, and kinesthetic pathways. When students see supporting visuals, listen to pronunciation models, and respond through interactive activities, they build layered encoding that makes information easier to store in long-term memory. The study confirms that enjoyable and meaningful sensory experiences enhance memory stickiness, particularly for vocabulary and language structures that require directed repetition (Gazioğlu & Karakuş, 2023; Jubran, 2012). Academically, these findings reinforce the position of MSL as an approach capable of producing deeper processing and stronger memory stability compared to monomodal learning.

3.2.2. Higher Engagement

MSL encourages higher engagement through interactive and multimodal media presentations. Students show increased attention, concentration, and active participation when engaged in activities that combine dynamic visuals, responsive audio, and click-based exploration and manipulation of digital objects. This engagement is not only behavioral engagement, but also cognitive engagement, as students are encouraged to evaluate and modify their performance through multimodal feedback. Research by Wu & Tai (2016) shows that sound wave visualization, pronunciation analysis, and audio comparison improve students' focus on linguistic details that were previously difficult to identify independently. This proves that multisensory engagement expands attention span and perseverance in language learning.

3.2.3. Improved Learning Motivation

Learning motivation increases significantly when the learning environment presents rich, enjoyable, and curiosity-stimulating multisensory elements. The use of avatars, responsive animations, sound effects, and instant feedback creates an immersive and engaging learning atmosphere, encouraging students to voluntarily repeat activities. Findings by Gazioğlu & Karakuş (2023) indicate that multisensory stimuli directly enhance intrinsic motivation through the activation of positive emotions during learning. This approach also supports sustained motivation because the learning experience is not monotonous, and students feel progress through visual indicators. Theoretically, these findings reinforce the concept that intrinsic

motivation can be enhanced through meaningful, multimodal, and emotionally supportive learning experiences.

3.2.4. Increased Self-Confidence

Students' confidence increases through web technology features such as voice recording, pronunciation comparison, and automatic feedback. These features enable safe practice without social pressure, allowing students to improve their performance independently before performing in front of others. Sahlan's (2022) study shows that multisensory-based roles and simulations help students express English more naturally, increase their courage to speak, and reduce their fear of making mistakes. Thus, MSL not only improves linguistic skills but also self-confidence, which is an important prerequisite in EFL learning. Academically, these findings confirm that multimodal feedback and private practice spaces provide psychological safety in language acquisition.

3.2.5. More Independent Learners

Learning independence increases because MSL provides adaptive features such as self-paced progression, replay, and exploratory activities that allow students to set their own learning pace. Nosrati (2015) asserts that the flexibility of web technology supports the development of self-regulated learning, as students control their learning strategies, monitor their progress, and evaluate their performance independently. MSL also provides space for experimentation and revision, so that students are not merely recipients of knowledge, but managers of their own learning process. Theoretically, these findings expand the literature on digital learning autonomy by showing that multisensory learning strengthens learner agency.

3.2.6. More Stable Focus

MSL plays a role in improving focus stability, mainly because visual and audio stimuli are designed to maintain attention without causing extraneous overload. Students show an increased ability to maintain attention on a single task for longer when multisensory stimuli are synchronized and relevant. Sound visualization, animation, and avatar responses help maintain focus by providing clear and directed cues. These findings are also in line with multimedia design principles such as signaling and temporal contiguity, which help focus students' attention on key information. These results reinforce the argument that MSL provides structured attention support that is not always available in conventional learning.

3.2.7. Reduced Anxiety through Social Support

Social support from parents and teachers plays an important role in reducing anxiety associated with web-based learning. When students receive guidance in understanding multisensory stimuli, they feel more confident and less overwhelmed by the complexity of digital stimuli. Mason et al. (2019) emphasize that social scaffolding helps guide students' interpretations, reduces confusion, and provides emotional stability during the online learning process. Parents also support consistency in learning at home and provide positive reinforcement that strengthens motivation and emotional calm (Gazioğlu & Karakuş, 2023), anxiety reduction in MSL does not only come from technology, but also from the surrounding social support context.

Overall, these seven main impacts show that MSL has a comprehensive effect on the cognitive, affective, social, and metacognitive domains. Retention, motivation, focus, and self-confidence increase; engagement becomes richer; learning autonomy develops; and anxiety

decreases through social support. These findings reinforce that MSL is not merely a technology-based approach, but a comprehensive pedagogical framework that holistically integrates sensory modalities, emotional support, and social interaction.

4. CONCLUSION

This study demonstrates that the Web-Based Multisensory Learning (MSL) framework is effective in improving the quality of English language learning through the integration of visual, auditory, and kinesthetic modalities, which strengthen cognitive connections, emotional engagement, and learning motivation. The findings for RQ1 affirm that a successful MSL design relies on multisensory engagement, emotional regulation, appropriate multimedia technology integration, learner personalization, and social support. Meanwhile, RQ2 reveals that the implementation of this framework leads to positive outcomes, including increased retention, engagement, motivation, confidence, learner autonomy, more stable focus, and reduced anxiety through social support. Thus, this study successfully addresses the research objectives and questions by showing that MSL can serve as a comprehensive approach that supports language acquisition cognitively, affectively, and socially. Theoretically, the findings reinforce the position of MSL as an approach that connects multimedia theory, affective theory, and autonomy-based learning within digital contexts. Practically, this framework—alongside the proposed implementation guidelines—offers a concrete instructional design blueprint for teachers, software designers, and institutions building next-generation web-based language learning platforms. However, this study is limited by its contextual scope and reliance on literature synthesis without direct empirical testing. Future research should conduct quantitative experimental studies and longitudinal trials across diverse educational levels to validate the framework's direct impacts on language proficiency metrics. Furthermore, upcoming research could investigate the integration of artificial intelligence (AI) and immersive technologies (AR/VR) within the MSL framework to enhance personalized real-time feedback and dynamic multimodal interactions in online English instruction.

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