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A scoping review of self-regulation within technology-mediated language learning

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ABSTRACT

This study explores how self-regulated learning (SRL) is conceptualized and operationalized within Technology-Enhanced Language Learning (TELL), with particular emphasis on web-based listening instruction (WBLI). Through a qualitative scoping review, the study synthesizes conceptual, theoretical, and empirical research to map dominant frameworks, regulatory dimensions, and digital tools that support SRL in language learning. The findings reveal that although SRL is widely recognized as essential in digital environments, existing studies demonstrate fragmented conceptualizations, often emphasizing cognitive and metacognitive strategies while overlooking motivational, affective, behavioral, and socially mediated aspects. The review highlights that SRL in WBLI is dynamically shaped by interactions among learners, technological features, and learning tasks, rather than by internal strategies alone. Digital tools such as interactive transcripts, feedback dashboards, and reflective prompts offer meaningful support, yet their pedagogical integration remains inconsistent. The study proposes a more holistic, multidimensional perspective of SRL that incorporates cognitive regulation, emotional control, co-regulation, strategic transfer, and ecological management. This synthesis contributes to a clearer conceptual foundation for designing SRL-supportive digital listening environments and offers guidance for future research and instructional innovation.

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1. INTRODUCTION

In today's digitally mediated era, language learning has increasingly moved beyond traditional classroom boundaries, requiring learners to develop greater autonomy, flexibility, and personal agency in managing their learning processes. This shift aligns with the growing

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prominence of self-regulated learning (SRL), which enables learners to consciously direct their cognitive, motivational, and behavioral engagement with learning tasks, as grounded in the works of Zimmerman (2002) and Schunk and Greene (2018). Within this evolving landscape, technology plays a crucial role not merely as an instructional tool but as a catalyst that fosters independent and strategic learning. Panadero (2017) emphasizes that SRL has become a foundational component of lifelong learning, making it essential in contemporary digital education. The rise of Technology-Enhanced Language Learning (TELL) further illustrates this transformation, as digital tools from mobile applications and virtual reality environments to AI-based chatbots and adaptive platforms provide learners with unprecedented opportunities to regulate their pace, track progress, and personalize learning strategies. Research has shown that when learners access technological features such as reflective prompts, feedback loops, and goal-setting dashboards, their language development becomes more meaningful and sustained (Lai et al., 2022; An et al., 2021).

Despite the increasing significance of SRL within TELL environments, existing studies reveal substantial conceptual fragmentation. Some investigations emphasize cognitive and metacognitive strategies (Luo & Zhou, 2024), while others highlight motivation, emotional regulation, or environmental structuring (Waluyo et al., 2024). This lack of coherence makes it difficult for educators and researchers to design pedagogical interventions or digital tools that effectively support SRL processes. Moreover, the inconsistent application of theoretical models such as Zimmerman's cyclical framework (2000), Pintrich's model of self-regulation (2003), and Bandura's Social Cognitive Theory (1986) further complicates efforts to unify the field. While these theories are often referenced, they are seldom integrated in a systematic or comparative manner, resulting in studies that lack a shared conceptual foundation. As Panadero (2019) notes, SRL can only be fully understood when theory, practice, and reflection align.

Given these conceptual and theoretical challenges, the present study adopts a scoping review approach aimed at consolidating and synthesizing the current landscape of research on SRL within TELL. Unlike systematic reviews that typically focus on the effectiveness of specific interventions, a scoping review maps the breadth and depth of the research field, identifying patterns, recurring themes, inconsistencies, and gaps in knowledge (Arksey & O'Malley, 2005; Levac et al., 2010). This approach is especially appropriate for TELL, a rapidly evolving domain where technological innovation often advances more quickly than empirical synthesis. As global disruptions such as the COVID-19 pandemic accelerate the shift toward digital learning environments, learners are expected to demonstrate heightened independence, strategic awareness, and resilience. Yet not all learners possess the skills required to thrive in these environments, making it crucial to understand how SRL functions within diverse technological modalities. Furthermore, as AI-driven tools and mobile platforms increasingly mediate language learning experiences, the intersection between SRL and digital innovation becomes a vital area of research that requires deeper scholarly attention (Roe & Perkins, 2024; Lai, 2024).

The problems that frame this inquiry emerge from several critical observations in the existing literature. First, digital listening and language learning practices often lack grounding in established pedagogical theories, resulting in instructional activities that prioritize technological operations over language development. Second, there is an absence of coherent frameworks to guide the design of technology-mediated instruction across cognitive, affective, and metacognitive dimensions. Third, listening and other language skills are frequently conceptualized as passive processes, despite evidence that they involve complex strategic, inferential, and metacognitive components. Fourth, the use of digital tools remains inconsistent, with educators often overlooking the affordances that support learner engagement and self-regulation. Fifth, many learning environments fail to foster learner

autonomy or provide scaffolding for self-regulated behaviors essential for successful language learning. Finally, rapid technological advancement is not always accompanied by pedagogical reflection, resulting in innovative tools that lack instructional depth or purposeful integration.

This study is delimited to a conceptual synthesis rather than empirical field investigations, drawing primarily from published academic literature that explicitly addresses web-based and technology-mediated approaches to language learning. The review does not incorporate studies focusing on other language skills or unpublished sources such as theses and practitioner reports, which may offer additional but non-peer-reviewed perspectives. Its focus is directed toward three interrelated areas: the pedagogical affordances provided by digital technologies in listening and language learning; the cognitive and technological challenges associated with implementing these tools in formal education settings; and the instructional transformations prompted by web-based environments within higher education contexts. Given that much of the existing research is produced in technologically advanced learning environments, caution is recommended when applying the findings to settings with limited resources or distinct sociocultural conditions, such as those experienced by many EFL learners in Southeast Asia.

In light of these considerations, the present study aims to map and synthesize the conceptualizations and theoretical frameworks of self-regulated learning that underpin current research in TELL, identifying dominant models, paradigms, and conceptual variations. It also seeks to categorize the dimensions, strategies, and technological tools reported across empirical studies that support SRL in digital language learning environments, examining how these elements are operationalized and measured. By addressing these aims, the review contributes to a more integrated conceptual understanding of SRL within TELL, highlights theoretical alignments and instructional implications, and offers guidance for future research. Ultimately, this synthesis supports the development of pedagogical practices that foster greater learner autonomy, reflective engagement, and strategic behavior in digitally mediated language learning. The paper proceeds by explaining the review methodology, presenting the thematic findings, and discussing their broader implications for research, technology design, and instructional practice.

2. METHODS

This study employed a qualitative scoping review approach based on the frameworks of Arksey and O'Malley (2005), Levac et al. (2010), and Peters et al. (2020). This design was chosen to map the conceptual, theoretical, and empirical development of self-regulated learning (SRL) within technology-enhanced language learning (TELL) without evaluating the quality of evidence. Relevant literature was collected through systematic searches in Scopus, Web of Science, ERIC, and Google Scholar, focusing on publications from 2005 to 2024 using keywords related to SRL, TELL, digital tools, metacognition, and learner autonomy. Peer-reviewed studies discussing SRL processes or digital support for autonomous learning were included, while non-peer-reviewed works and studies unrelated to language learning were excluded. Data were collected by extracting key information into a review matrix documenting each study's aims, theoretical basis, tools examined, and SRL components addressed. The analysis followed a thematic synthesis process, beginning with coding extracted data, grouping the codes into broader themes, and synthesizing these themes into an integrative conceptual map of how digital affordances support SRL. To ensure rigor, the review applied theoretical triangulation, reflexive memoing, peer debriefing, and transparent documentation of procedures. As the study involved only published literature, ethical approval was not required. A digital writing assistant (ChatGPT,

OpenAI, 2025) was used solely for language refinement, while all interpretations were made independently by the researcher.

3. RESULTS AND DISCUSSION

This section presents the main findings of the conceptual synthesis on self-regulated learning within web-based listening instruction. The results are organized by identifying recurring themes, regulatory processes, and technological features that appear across the literature. Each theme is discussed by connecting empirical evidence with relevant theoretical perspectives to show how learners regulate their cognition, motivation, emotions, and interactions with digital tools during online listening activities. The discussion further highlights how these patterns contribute to a deeper understanding of SRL in technology-enhanced environments and what implications they offer for designing more effective and learner-centered digital listening instruction.

3.1. Conceptualizations and Theoretical Frameworks of Self-Regulated Learning Technology-Enhanced Language Learning (Tell)

The present study examined how self-regulated learning (SRL) has been conceptualized within Technology-Enhanced Language Learning (TELL), with a specific focus on its applications to web-based listening instruction (WBLI). To address the research problem, the study synthesized seven major theoretical frameworks: Zimmerman's Cyclical Model, Pintrich's SRL Framework, Bandura's Social Cognitive Theory, the Metacognitive Listening Framework, Oxford's Strategic Self-Regulation (S^2R) Model, Azevedo's Model of SRL in Hypermedia, and Sociocultural Perspectives on SRL. The synthesis was conducted through a conceptual analysis of empirical studies, design-oriented research, and theoretical literature published over the past two decades. Through this analysis, the study sought to reveal not only how SRL is defined and operationalized in TELL contexts, but also how these conceptualizations shape the design, enactment, and pedagogical potential of WBLI. The findings demonstrate that while SRL is widely acknowledged as essential for effective digital listening, the ways in which it is theorized remain uneven, fragmented, and often limited to cognitive or metacognitive dimensions. As a result, this study proposes an integrated understanding of SRL in WBLI that incorporates cognitive, motivational, social, affective, and tool-mediated dimensions of learner regulation.

The first major finding concerns how SRL has been conceptualized across the seven frameworks. Analysis of the literature reveals that Zimmerman's phase-based model remains the most dominant approach, mainly because it aligns easily with the structured sequence of pre-, while-, and post-listening tasks commonly used in WBLI. Studies grounded in this model often highlight learners' ability to set goals, monitor their comprehension, and reflect on difficulties. However, the findings also show that these applications tend to overlook important contextual factors such as digital distractions, affective states, and learners' interaction with technological tools. Meanwhile, Pintrich's multidimensional model expands the conceptual scope by integrating motivational and contextual regulation, but its application in WBLI remains inconsistent. Many studies cite the model yet operationalize only its cognitive or metacognitive components, leaving motivational and behavioral aspects underdeveloped. The literature indicates that learners must manage not only comprehension processes but also environmental distractions, frustration, and time allocation—dimensions that are central to SRL in digital contexts but are frequently ignored. The synthesis thus shows that existing conceptualizations do not fully capture the complexity of SRL as it emerges in technology-rich listening environments.

In terms of methodological orientation, the reviewed studies obtained findings mainly through strategy surveys, interviews, task-based observations, log-data from learning platforms, and experimental comparisons between scaffolded and non-scaffolded WBLI designs. These methodological patterns illuminate how researchers infer learners' self-regulatory behaviors, but they also reveal significant gaps. Much of the existing evidence derives from learners' self-reported strategy use rather than from real-time behavioral data that would capture how learners navigate digital listening tasks moment to moment. Studies that draw on platform logs or process tracing (e.g., pause behaviors, navigation paths, replay patterns) provide richer insights into learners' regulatory decisions, suggesting that SRL in WBLI is dynamic, fluid, and mediated by the affordances of technology. However, these process-oriented studies are still scarce, which limits our understanding of how learners' strategies unfold over time. Therefore, the findings suggest a need for methodological expansion toward more temporally sensitive, technology-integrated approaches to SRL research in listening.

Interpreting these findings reveals several patterns about how learners regulate their listening in technology-mediated contexts. First, SRL in WBLI appears to be more situationally triggered than internally stable. Learners often adjust strategies in response to task difficulty, interface complexity, or moments of comprehension breakdown, rather than following a predetermined strategic plan. This aligns strongly with Azevedo's model, which emphasizes real-time decisions in hypermedia environments and suggests that SRL is emergent, adaptive, and co-constructed through tool interaction. Second, emotional and motivational regulation emerges as a key but neglected factor. Learners frequently report anxiety, fatigue, or loss of concentration in WBLI, especially when tasks involve authentic materials or fast speech rates. These affective fluctuations influence learners' strategy choices, persistence, and focus, yet many WBLI designs lack features that scaffold emotional regulation. Oxford's S^2R model offers a theoretical foundation for addressing these dimensions, but its influence on WBLI design remains limited. Third, the findings highlight the importance of teacher and peer mediation as external sources of regulation. Even in digital contexts, learners benefit from modeling, dialogic questioning, and collaborative reflection—elements emphasized in sociocultural perspectives but underrepresented in current WBLI practice. These interpretations demonstrate that SRL in digital listening cannot be understood solely through cognitive models; rather, it must be viewed as an interplay of internal processes, external scaffolds, and technological mediation.

Connecting these findings to existing knowledge reveals both alignments and tensions. The prominence of metacognitive strategy training in WBLI echoes longstanding research in listening pedagogy that identifies planning, monitoring, and evaluation as key predictors of listening success. Similarly, the emphasis on motivational and emotional regulation resonates with social cognitive theory, which underscores the role of self-efficacy in sustaining engagement. However, the findings also challenge traditional assumptions in SRL and listening research. Linear models of strategy use do not reflect the nonlinear, user-driven nature of digital listening, where learners rewatch, skip, adjust captions, or toggle features based on immediate needs. The findings also complicate the notion of autonomy: rather than independent self-direction, effective SRL often involves co-regulated and socially mediated learning, requiring an ecological view of regulation rather than an individualistic one. Additionally, the findings highlight a mismatch between the theoretical richness of models like the S^2R and sociocultural frameworks and their limited practical application in WBLI design. This gap suggests that SRL theory has outpaced pedagogical innovation in digital listening instruction.

Drawing from these insights, the study offers several contributions to theory. First, it proposes an integrated SRL-in-WBLI model that synthesizes the strengths of the seven

frameworks. This model conceptualizes SRL in digital listening as a multi-layered process involving cognitive and metacognitive strategies (as emphasized by Zimmerman, Pintrich, and the Metacognitive Listening Framework), motivational and emotional regulation (as highlighted by Bandura and Oxford), adaptive tool-mediated navigation (as described by Azevedo), and socially distributed regulation (as foregrounded in sociocultural perspectives). Second, the findings suggest that SRL in WBLI should be understood as dynamically distributed across learners, tools, tasks, and social actors, rather than as a purely psychological attribute of the individual. This reconceptualization shifts SRL from an internal trait to an ecological system of regulation. Third, the study proposes that future WBLI designs incorporate adaptive scaffolds, reflective analytics, and collaborative regulatory prompts to support learners across all dimensions of SRL. These theoretical extensions contribute to a more holistic understanding of SRL in TELL and provide a foundation for developing more responsive, learner-centered digital listening environments.

In summary, the results and discussion indicate that while SRL is widely acknowledged as essential for effective web-based listening, its conceptualization across existing frameworks remains fragmented. By synthesizing seven major models, this study advances a more complete understanding of SRL as a dynamic, multi-dimensional, technologically mediated process. The proposed integrated model offers a theoretical contribution that can guide the design of future WBLI environments and support learners not only in comprehending spoken texts but also in managing themselves as strategic, reflective, and adaptive language users in digital contexts.

3.2.Dimensions, Strategies, and Tools of Self-Regulated Learning in TELL Contexts

The findings of this study address the research question concerning which dimensions, strategies, and tools of self-regulated learning (SRL) are identified across empirical studies in technology-enhanced language learning (TELL), particularly in web-based listening instruction (WBLI), and how these elements are operationalized in practice. The results reveal a multilayered structure of SRL that spans cognitive, metacognitive, affective, social, behavioral, and motivational dimensions, each enacted through specific strategies and supported by various technological tools. These findings were obtained through a conceptual and empirical synthesis of peer-reviewed studies published in the last decade, with attention to recurring constructs, convergent patterns, and forms of operationalization reported across diverse learning contexts. Through thematic mapping, the study identified not only the strategies and tools but also the ways in which those tools shape, facilitate, or limit learners' regulatory processes. Together, the findings illuminate a complex, interconnected, and occasionally fragmented landscape in which SRL is practiced and supported in digital listening environments.

The synthesis demonstrates that the cognitive dimension of SRL in TELL environments is most often manifested through learners' efforts to select key information, infer meaning, reorganize input, and summarize content during listening. Empirical studies consistently show that cognitive processes are supported through digital resources such as interactive transcripts, podcasts, adjustable playback features, and multimedia platforms like YouTube. These tools help learners externalize cognitive effort by enabling replay, comparison, prediction, or segmentation of input, thereby strengthening comprehension. The findings were obtained by comparing operational descriptions in empirical literature, which consistently showed that cognitive engagement increases when learners are given agency to manipulate auditory input. However, interpretation of these results suggests that cognitive regulation alone is insufficient without accompanying metacognitive and motivational support. While digital tools do facilitate cognitive strategy use, the effectiveness of these

tools largely depends on how learners are taught to use them intentionally rather than reactively. This aligns with previous scholarship that emphasizes the importance of strategy awareness and regulated cognitive engagement in digital listening environments.

Across the studies reviewed, metacognitive regulation emerges as one of the most frequently emphasized dimensions within WBLI. Learners are expected to engage in planning before tasks, monitoring during listening, and evaluating their performance afterward. The findings show that embedding structured sequences within tasks such as pre-listening goal setting, strategic prompts, and post-task reflection journals strengthens learners' ability to anticipate challenges, track comprehension, and adjust strategies accordingly. These findings were obtained from intervention studies that implemented metacognitive instruction or integrated reflective tools, demonstrating clear improvements in learners' comprehension and strategy use. The interpretation of these findings indicates that metacognition serves as the backbone of self-regulation in digital listening settings, as it binds cognitive strategies to conscious decision-making and learning awareness. When linked to existing literature such as Zimmerman's cyclical model or Pintrich's expectancy-value framework, the findings reinforce the argument that metacognitive scaffolds enable learners to transition from passive receivers of input to active managers of their learning. Moreover, the results indicate a potential theoretical extension: in WBLI contexts, metacognition is not merely an internal process but is actively distributed across technological tools, implying a model of externally mediated metacognition that existing theories do not fully articulate.

The affective dimension also plays a substantial role in shaping SRL in digital listening contexts. The findings show that affective regulation specifically anxiety control, motivation maintenance, and emotional resilience is operationalized through progress dashboards, gamified badges, AI-driven encouragement, and learner-controlled pacing. These conclusions were drawn from studies that examined learners' emotional responses to web-based listening tasks and monitored changes in motivation through surveys, interviews, and learning analytics. Interpretation of these findings suggests that affective scaffolds are particularly crucial for learners with lower proficiency or limited experience in autonomous learning environments, as technological complexity and authentic auditory input can create emotional overload. Linking these findings to existing literature highlights a persistent gap in SRL theory, wherein emotional regulation is acknowledged but not extensively operationalized in relation to digital tools. The results point to a need for broadening theoretical models of SRL to include not only cognitive and metacognitive control, but also affective and identity-based dynamics shaped by the digital learning ecology.

A significant dimension emerging from the data is social and co-regulation, which refers to regulatory processes shared with peers, teachers, or digital agents. The findings indicate that SRL does not develop in isolation; rather, it emerges through dialogic interaction, teacher modeling, and peer collaboration facilitated by tools such as shared journals, peer feedback platforms, discussion forums, and collaborative annotation systems. These findings were obtained from qualitative and mixed-method studies that captured learners' interaction patterns and reflective dialogue. Interpretation of these findings reveals that co-regulation facilitates the internalization of strategies by making invisible cognitive processes visible through social discourse. When connected to sociocultural theory, the results reaffirm the idea that SRL is a developmental trajectory shaped by guided participation rather than an innate individual capacity. The evidence suggests the need to extend theoretical models of SRL by embedding co-regulatory pathways and digital mediation into the conceptual structure, thus proposing a hybrid model that integrates psychological and sociocultural perspectives.

Another dimension identified is strategic transfer, which refers to learners' ability to adapt strategies across different listening tasks, tools, and contexts. The findings reveal that strategic transfer is supported by digital portfolios, multimodal listening modules, and systems that prompt learners to evaluate strategy effectiveness across tasks. These observations were obtained from longitudinal or multi-task studies that tracked learners across multiple listening episodes. Interpretation suggests that transfer develops gradually when learners are encouraged to compare their strategic choices, evaluate results, and refine their approaches. These findings connect directly to the literature that views SRL as a cyclical and developmental process, yet the study's results highlight a gap: although learners often use strategies effectively within individual tasks, many struggle to generalize them across new contexts without explicit reflective or scaffolded support. This indicates the need for a more explicit theoretical integration of strategy-transfer mechanisms within SRL models for TELL environments.

Behavioral and environmental regulation also emerged as essential but often overlooked dimensions. The findings show that learners regulate their time, select resources, and manage their physical or digital learning environment through tools such as learning management systems (LMS), scheduling apps, mobile notifications, and resource libraries. These findings were obtained from studies that incorporated learning analytics or self-report measures and documented patterns of engagement or avoidance. Interpretation suggests that behavioral regulation is closely intertwined with learners' digital literacy and their ability to manage technological complexity. When linked to prior scholarship, these results echo arguments that SRL in digital environments requires not only strategic knowledge but also environmental orchestration skills. This suggests a theoretical refinement: SRL in WBLI involves ecological regulation in which learners must manage not only themselves but also the learning environments mediated by technology.

The synthesis also highlights the central role of self-efficacy support in shaping learners' engagement in digital listening. Findings show that learners with stronger self-efficacy use more strategies, persist longer, and respond better to digital feedback. These results were obtained through correlational and experimental studies that assessed learners' beliefs alongside performance metrics. Interpretation suggests that digital feedback systems that personalize progress, affirm effort, or offer adaptive challenges can significantly strengthen learners' confidence and resilience. When connected to Bandura's theory, the findings suggest the need to reconceptualize self-efficacy in digital contexts as a feedback-sensitive construct shaped by real-time analytics, interface design, and learner-control features, thus calling for a technological extension of classical self-efficacy theory.

In general, the results show that while a wide range of SRL dimensions, strategies, and tools are present in WBLI, the operationalization of these components is uneven across studies. Many platforms include features that could support SRL but fail to provide the pedagogical scaffolds necessary for learners to use them strategically. This finding was obtained through cross-study comparison that revealed a pattern of tool availability without corresponding instructional guidance. Interpretation indicates a widespread assumption that learners are naturally capable of self-direction, which contradicts evidence from both SRL theory and empirical research. When situated within existing scholarship, the findings reveal a gap between theoretical understanding of SRL and its practical implementation in TELL. This discrepancy suggests a need for more integrated, pedagogically principled designs rather than tool-centric or strategy-isolated interventions.

Together, these findings give rise to new theoretical and pedagogical implications. First, SRL theory should be expanded to incorporate digital mediation as a central rather than peripheral component. Classic models conceptualize SRL as internally driven, but WBLI environments reveal that regulation is often externally scaffolded through digital

tools, interfaces, and automated feedback systems. Second, sociocultural pathways of SRL development need to be integrated into digital SRL models, acknowledging that regulation grows through guided interaction rather than isolated cognition. Third, SRL frameworks should explicitly include strategy-transfer mechanisms, affective dynamics, self-efficacy development, and ecological regulation as essential components in technology-rich environments. Finally, a more holistic and multidimensional framework is needed to bridge the conceptual fragmentation in the field, offering educators and designers a clearer blueprint for creating SRL-supportive digital listening environments that are cognitively enriching, emotionally supportive, socially inclusive, and developmentally responsive.

4. CONCLUSION

This study examined how self-regulated learning (SRL) is conceptualized and operationalized within Technology-Enhanced Language Learning (TELL), with particular attention to web-based listening instruction (WBLI). By synthesizing seven major theoretical frameworks and a wide range of empirical findings, the study reveals that SRL in digital listening contexts is far more complex than traditional models suggest. While existing research frequently emphasizes cognitive and metacognitive strategies such as planning, monitoring, and evaluation, the findings show that effective SRL in WBLI also depends on motivational, emotional, social, behavioral, and tool-mediated processes. Learners regulate not only comprehension but also their engagement, emotions, environment, and interactions with technological features, making SRL a dynamic and situationally responsive system rather than a fixed set of internal skills.

The overall synthesis indicates that current conceptualizations and designs of WBLI do not yet fully capture this multidimensional nature. Many platforms offer SRL-supportive features, but these tools often lack the pedagogical scaffolding needed to help learners use them strategically. Theoretical gaps also persist, particularly in addressing affective regulation, co-regulation, ecological management, and real-time decision-making within digital environments. To address these gaps, the study proposes an integrated model that reconceptualizes SRL in WBLI as an ecological, socially mediated, and technologically distributed process. This broader perspective provides a foundation for designing more adaptive, holistic, and learner-centered WBLI environments that support not only listening comprehension but also the broader development of strategic, reflective, and self-directed learners.

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