Curriculum Research
Volume 6, Issue 3
Sept. 20, 2025

The Role of Materials in Teaching Listening Strategies in Computer-based and Text-based Classes: EFL Learners' Listening Comprehension and Cognitive Load in Focus

Article Type:

Original Research

Authors:

Maral Katal[1]
ORCiD: 0000-0002-0638-5226
Mojgan Rashtchi[2]
ORCiD: 0000-0001-7713-9316
Arshya Keyvanfar[3]
ORCiD: 0000-0003-2803-5910

Article History:

Received: 2025.06.12
Accepted: 2025.09.16
Published: 2025.09.20

Abstract

Listening effectively in a foreign language presents many challenges for students. The aims of this convergent mixed methods study were two-fold. First, to determine whether teaching listening strategies through materials tailored to apply principles related to decreasing Cognitive Load (CL) could help learners improve their L2 listening comprehension. Second, whether using such materials could reduce learners' cognitive load. In doing so, two modes of material presentation (computer-based and text-based) were selected. Eighty-eight TEFL bachelor students in three intact classes were randomly assigned to three treatment conditions: Strategy-Based Cognitive-Load-Decreasing Computer-Based Material (SB-CLD-CBM), Strategy-Based Cognitive-Load-Decreasing Text-Based Material (SB-CLD-TBM), and Strategy-Based Non-Cognitive-Load Decreasing Conventional Learning Material (SB-NCLD-CLM), and received relevant instructions. A general proficiency test was used to examine participants' language proficiency. A listening pretest and posttest, a listening achievement test, and a cognitive load questionnaire were used to collect data in the quantitative phase. A reflection paper, including two questions about students' perceptions administered during the treatment, was used to gather qualitative data. The One-way Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA) showed that CLD-CBM and CLD-TBM outperformed the NCLD-CLM in listening comprehension and experienced lower cognitive load. However, no significant difference was found between the experimental groups. The findings are valuable for teachers and materials developers, suggesting they should include Cognitive Load Theory principles and strategy instruction when designing learning materials and instructional approaches.

Key Words: Cognitive Functioning, Computer-based and Text-based Classes, Learning Materials, Listening Comprehension, Listening Strategies

1. Department of Teaching English as a Foreign Language, NT.C., Islamic Azad University, Tehran, Iran. Email: M.katal@iau.ac.ir
2. Department of Teaching English as a Foreign Language, NT.C., Islamic Azad University, Tehran, Iran (Corresponding Author). Email: m_rashtchi@iau.ac.ir
3. Department of Teaching English as a Foreign Language, NT.C., Islamic Azad University, Tehran, Iran. Email: a_keyvanfar@iau.ac.ir

1. Introduction

L2 learners' challenges in completing listening tasks partly stem from the high mental effort required by the skill (Goh & Vandergrift, 2021). The strategic approach, based on the socio-cognitive paradigm, provides a viable solution for enhancing listening comprehension (He & Jiang, 2020). According to Vandergrift and Cross (2018), learning strategies act as practical tools that help students better manage listening tasks by addressing their weaknesses. They give learners cognitive and metacognitive awareness to perform listening activities. Although many studies have explored listening strategies, students and teachers still face difficulties caused by various factors that impede listening success (Goh & Vandergrift, 2021). EFL learners, especially in Iran, face several obstacles in completing listening tasks (Haghighi et al., 2019), emphasizing the need for further research into the variables involved in the comprehension process.

Aside from listening-related elements, one factor influencing listening comprehension is Working Memory (WM), which is affected by learning materials, learning tools, instructional steps, and procedures (Masrai, 2020; Sweller, 2016). Some learning materials place a significant burden on students' mental state and consume their memory resources, resulting in poor listening comprehension (Jiang, 2024). One issue that helps learners handle listening tasks more effectively is to free up their cognitive resources and WM capacity (Paas & van Merriënboer, 2020). Guidance on how to listen effectively can reduce their Cognitive Load (CL) and improve listening skills (Sayyadi, 2019). While CL involves human cognitive structures, designing appropriate educational content and teaching strategies can help learners overcome challenges they face while listening and understanding (Sweller et al., 2011). Cognitive Load Theory (CLT) emphasizes that minimizing the load on WM is essential (Sweller, 2016) and provides guidelines for presenting new information to optimize learners' mental performance (Retnowati et al., 2018).

Similarly, the use of appropriate design procedures in learning materials (Ghalandar-Zehi et al., 2024) is suggested to enhance students' Working Memory Capacity (WMC) (Lwande et al., 2021). Learning materials play a significant role in shaping students' cognitive dispositions and WM mechanisms across various domains of knowledge (Leahy & Sweller, 2011), including listening comprehension (McNamara & Scott, 2001). Accordingly, considering the prominence of listening strategies and CL in fostering learning conditions, and observing students' problems with listening comprehension, the researchers in the current study investigated whether teaching listening strategies through materials designed to apply principles related to decreasing CL could help learners improve their L2 listening comprehension. Besides, whether using such materials could generally reduce their CL. Therefore, by teaching listening strategies and designing materials, the researchers aimed

to alleviate the cognitive burden on students and enhance their listening comprehension. In designing the materials, the researchers followed the twelve instructional design principles identified by Chen et al. (2017) within the CLT framework, which was grounded in empirical research and aimed to optimize learning by managing the cognitive demands placed on learners.

The present study could be significant as it posited that learners' success in listening comprehension was partially contingent upon the CL they experienced during listening tasks. This investigation highlighted the importance of strategies for enhancing listening outcomes. Also, it presumed that reducing the cognitive burden imposed by educational materials could contribute to students' mastery of the skill. The educational materials in this study were tailored through two modes of learning: computer-based and text-based, as explained in the Procedure section.

2. Review of the Related Literature

Listening demands significant mental effort, as listeners must simultaneously discriminate between sounds, interpret intonation and stress, and comprehend vocabulary and grammatical structures (Field, 2008). Vandergrift and Cross (2018) emphasized that listening comprehension and the application of listening strategies help students process language input and perform at the highest level in language learning. The prominence of listening strategies occurs when the listener focuses not only on the listening content but also on how to listen. According to Vandergrift (2004), effective listening requires learners to engage in metacognitive strategies, focusing not only on the content but also on how they process auditory input.

Similarly, adopting a strategic approach is essential for improving receptive auditory processing and has shown promising results in listening comprehension thus far (Nilforoushan et al., 2024); nonetheless, empirical work outside research settings has revealed that students continue to encounter difficulties with listening comprehension (Haghighi et al., 2019). Goh and Vandergrift (2021) and Vandergrift and Cross (2018) proposed effective strategies that enable learners to approach listening tasks with increased efficacy. The instructional phases guide students in organizing cognitive and metacognitive strategies to accomplish a listening task within the framework of pre- listening, while-listening, and post-listening stages.

Teachers should explicitly explain or show each listening strategy in addition to discussing its role in helping learners manage and regulate their listening within a given stage. Teachers should provide students with multiple practice opportunities using strategies, in

addition to encouragement and feedback, to consolidate their understanding. Moreover, exposing learners to a range of different types of listening texts is warranted to promote the transfer of metacognitive strategies across various listening contexts. As learners become more adept at employing metacognitive strategies, teachers reduce the amount of input, feedback, and review to promote independent use and self-evaluation of strategies. As Vandergrift and Cross (2018) argue, separating teaching cognitive from metacognitive strategies is challenging, since while metacognitive strategies direct learning, cognitive strategies involve interaction with learning material; thus, the directive power of metacognitive strategies cannot be fully realized without the application of appropriate cognitive strategies.

An issue that significantly influences the successful performance of listening tasks is encompassed within the CLT proposed by Sweller (1988), which posited that learners have a limited capacity for processing information within WM. When cognitive demands exceed this capacity, learning outcomes decline. In the context of second language (L2) listening comprehension, the concurrent need to decode auditory input, interpret meaning, and retain information can impose a considerable cognitive strain (Field, 2008). Should the task design neglect to consider this load—such as by introducing unfamiliar vocabulary, rapid speech, or complex syntactic structures—learners may encounter difficulties in processing the input (Vandergrift & Goh, 2012). Consequently, instructional strategies aimed at reducing extraneous CL and fostering germane load—such as pre-listening activities, visual aids, or guided strategy instruction—can substantially improve listening performance. Thus, understanding and applying CLT within listening pedagogy offers a valuable framework for optimizing task design and supporting learners' cognitive processing capabilities.

Satori (2021) emphasized that students predominantly face challenges related to memory overload and WM issues, which are critical factors for comprehension. This challenge aligns with CLT, which posits that CL depends on the capacity of WM (Sweller, 2016). Recent research has investigated the impact of CL on various facets of L2 acquisition (Liu et al., 2024). Specifically, some studies have identified the potential effects of CL (Satori, 2021), while others have acknowledged its detrimental impact on listening comprehension (Diao et al., 2007).

An extensively debated topic within the discipline concerns the influence of delivery modality on listening comprehension outcomes (Lehmann & Seufert, 2020) and the enhancement of listening skills through the integration of other competencies (Moussa-Inaty et al., 2012). Nonetheless, the debate about the most effective medium for L2 listening comprehension and how extraneous information affects CL remains unresolved (Chang et al., 2014). Sweller et al. (2011) suggested that the effects of CL vary depending on specific

instructional strategies, arguing that recognizing these effects can enhance learning. Chen et al. (2017) identified twelve key factors that help reduce CL (see Table 6).

A series of studies and meta-analyses on CLT and its effects on CL (Chen et al., 2017) have been proposed in various forms of computer-assisted learning, providing substantial empirical evidence for the instructional guidelines of the CLT framework (Sweller et al., 2011). However, the role of factors that can reduce CL during the process of mastering listening skills—and whether these factors can effectively facilitate listening comprehension—remains under-researched. While CLT (Sweller, 1988) has been widely applied in instructional design across various domains, its specific implications for L2 listening pedagogy are still being developed. Most existing studies focus on identifying challenges learners face during listening tasks, such as speech rate, lexical density, and syntactic complexity, rather than systematically exploring interventions that mitigate cognitive strain. For example, the potential benefits of scaffolding techniques, multimodal input, or strategic pre-listening activities are often acknowledged but not rigorously tested through empirical research.

As a result, there is a gap in understanding how instructional modifications—designed to reduce extraneous load and increase germane load—can be optimized to support learners' cognitive processing during listening. Addressing this gap is crucial for developing evidence-based approaches that not only improve comprehension outcomes but also promote long-term listening proficiency. Therefore, this convergent mixed methods study examined the effect of listening strategy instruction and cognitive load-reducing learning materials on students' listening comprehension and CL. CL principles are applied to redesign learning materials. Such materials are primarily used in computer-based classes; however, this study aimed to investigate whether presenting paper-and-pencil materials versus computer-based materials was more effective in enhancing listening comprehension and reducing CL. The research questions addressed in this study were as follows:

RQ1. Do listening instructions through Strategy-Based Cognitive-Load-Decreasing Computer-Based Material (SB-CLD-CBM), Strategy-Based Cognitive-Load-Decreasing Text-Based Material (SB-CLD-TBM), and Strategy-Based Non-Cognitive-Load Decreasing Conventional Learning Material (SB-NCLD-CLM) differently impact Iranian EFL learners' listening comprehension?

RQ2. Do listening instructions through Strategy-Based Cognitive-Load-Decreasing Computer-Based Material (SB-CLD-CBM), Strategy-Based Cognitive-Load-Decreasing Text-Based Material (SB-CLD-TBM), and Strategy-Based Non-Cognitive-Load Decreasing Conventional Learning Material (SB-NCLD-CLM)

differently impact Iranian EFL learners' cognitive load?

RQ3. How do the participants perceive their cognitive load when using SB-CLD-CBM and SB-CLD-TBM in listening classes?

3. Method

3.1. Design

The researchers employed a convergent mixed methods design to address the research questions. Both quantitative and qualitative data were collected concurrently and analyzed subsequently (Katz-Buonincontro, 2024). The quantitative phase was a quasi-experimental study utilizing a non-equivalent pretest-posttest control group design, implemented across three intact classes (Best & Kahn, 2006). The classes were randomly assigned to three different instructional methods. The study included two experimental groups (SB-CLD-CBM and SB-CLD-TBM) and one control group (SB-NCLD-CLM). The purpose of the control group was to determine whether the observed changes in the experimental groups were attributable to the intervention or chance (Campbell & Stanley, 1963; Mackey & Gass, 2021). Shadish et al. (2002) underscored that the validity of quasi-experimental studies without a comparison or control group is fundamentally compromised. In this investigation, the learning materials served as the independent variable, with three levels: strategy-based, cognitive-load-decreasing computer-based learning materials; strategy-based, cognitive-load-decreasing text-based learning materials; and strategy-based, non-cognitive-load-decreasing conventional learning materials. The dependent variables encompassed listening comprehension and CL.

3.2. Participants

Eighty-eight TEFL bachelor students selected from a pool of 120 learners who had enrolled in a university's regular listening and speaking courses (in three intact classes) participated in this study. The classes were randomly assigned to three treatment groups. The participants included both males and females, with ages ranging from 19 to 25 years old. The selection method was convenience sampling.

3.3 Instruments

A) General Proficiency Test (GPT): A sample of the Preliminary English Test (downloaded from https://www.cambridgeenglish.org) was administered to assess students' homogeneity in English proficiency. The test covered all four skills. The administration took 130 minutes. The test was initially piloted on a group similar to the study participants, consisting of 30 students. Two assistant professors scored the speaking and writing sections. Cronbach's alpha index (r = 0.88) confirmed its reliability. Since the test aimed to ensure homogeneity, 32 out of 120 participants were excluded and instructed by a different instructor in another class, under the supervision of the Head of the TEFL Department.

General Listening Test (GLT): The listening section of the GPT test was considered a General Listening Test (GLT) and served as both a pretest and a posttest. The 25-item test consisted of four listening tasks. The time spent on test administration was 30 minutes. The reliability of the test, as measured by Cronbach's alpha, was acceptable (α = 0.89).

B) Listening Achievement Test (LAT): To control the threat of practice effect, which could occur with the second administration of GLT, the researchers developed the LAT as a post-achievement test. The test consisted of 20 items and involved four sections, each with a different natural setting (e.g., a woman discussing her job). The B estimate was calculated (B: 6.84). The dependability index of the test was calculated using the approach proposed by Subkoviak (2005). The agreement coefficient and Kappa coefficient were 0.83 and 0.35, respectively.

C) Cognitive Load (CL) Questionnaire: NASA Task Load Index (Hart & Staveland, 1988) was used to investigate students' CL. The instrument provides an overall workload score calculated as the sum of six 20-point subscales: mental demand, physical demand, temporal demand, performance, effort, and frustration. The questionnaire was piloted on a sample similar to the study participants. The instrument's reliability index, calculated using Cronbach's alpha before application, indicated its viability (α = 0.91).

D) Reflection Paper: The researchers developed a reflection paper following the suggestions of several researchers for reflection checklists (Chen et al., 2017; Vandergrift & Cross, 2018). Goh (2014) suggests that students' reflection entries should be completed individually by answering questions about what, when, how, why, and who in relation to a specific listening event. Vandergrift and Goh (2012) believed that teachers should use prompts to maintain learners' focus on aspects of learning that require deep thinking and analysis. The reflection papers administered immediately after the listening activities and contained two questions, which helped students evaluate their performance in relation to the CL they experienced. The SB-CLD-TBM and SB-CLD-CBM groups answered the reflection

paper every other session after completing a listening task, answering the following questions:

≠ Did you feel (mental, physical, temporal) pressure while doing the listening task? How?

≠ Did you feel frustrated or ineffective? Why?

3.4. Materials

Generally, the materials for the SB-CLD-CBM and SB-CLD-TBM groups consisted of a set of listening strategies (Vandergrift, 1997) and 12 lessons adapted from the listening sections of *Passages One* (Richards & Sandy, 2014). This set of listening strategies included Persian translations and English explanations. Three bilingual experts translated, back-translated, and reviewed the listening strategy set to evaluate its accuracy and content validity. The materials were adapted based on the CL effects demonstrated by Chen et al. (2017) within the CLT framework. They were reorganized and edited according to the validated metacognitive pedagogical sequence for teaching listening strategies (Vandergrift & Cross, 2018). The metacognitive pedagogical sequence served as the fundamental framework for teaching listening strategies. The SB- NCLD-CLM group also covered 12 lessons from the listening sections of *Passages One*, but without any manipulation regarding CL effects. The group did not have access to the complete set of listening strategies. Teaching listening strategies was done implicitly, following the metacognitive pedagogical sequence proposed by Vandergrift and Tafaghodtari (2010), which mainly focused on embedded instruction. The addressed models are explained in detail herein.

3.4.1 Sequence of Pedagogical Steps (Vandergrift & Cross, 2018). The researchers redesigned the book's content, following the sequence proposed by Vandergrift and Cross (2018). Corresponding to each stage, the required tasks and listening texts were supplemented with specified listening strategies, and unnecessary parts were removed. The order and content of the presented material, as outlined in these instructional steps, were consistent across all treatment sessions (Tables 1-5).

Table 1.

Pre-listening Stage Activities

Pre-listening Stage	**Strategies**		
Pedagogical Sequence	**Cognitive**	**Metacognitive**	**Affective**
Students were prepared for what they were going to hear and what they were expected to do. Initially, students were informed about the topic (e.g., personality traits) and the type of text they would hear (e.g., a conversation between two friends) by providing students with texts, pictures, discussions, and	Elaboration Note-taking Resourcing Summarizing Inferencing Grouping	Planning Directed-attention	Cooperation Questioning-for Clarification

exercises that activated their prior knowledge, along with any relevant cultural information or supplementary material needed, presented in the form of relevant exercises. Second, students were informed about the purpose of listening (the goal-setting stage). Students would know the specific information they needed to listen for and the degree of detail required. After students got enough information about what they were going to hear, they made predictions to anticipate what they would hear. These predictions formed the backdrop against which listeners could use contextualization to guide their comprehension.			

Table 2.

While-Listening Stage Activities, First Stage

First Listen: First Verification Stage	**Strategies**		
Pedagogical Sequence	**Cognitive**	**Metacognitive**	**Affective**
Students verified predictions and checked comprehension of the desired information. Students were not required to understand every word. After completing their predictions, they listened to the text for the first time. As they listened, they highlighted the predicted words, phrases, and information mentioned in the text and added any other information they understood from the listening task. Students discussed and compared their predictions, adding information in pairs. They also identified their problem in concentrating during the second listen.	Grouping Transfer Elaboration Inferencing Imagery Summarization	Monitoring Planning Selective-attention	Self-encouragement Cooperation Questioning-for clarification

Table 3.

While-Listening Stage Activities, Second Stage

Second Listen: First Verification Stage	**Strategies**		
Pedagogical Sequence	**Cognitive**	**Metacognitive**	**Affective**
As listeners monitored their comprehension, they might face problems that impeded task completion. They might need to revise predictions, using other strategies, or both. They attempted to build upon what they had understood so far to fill in the missing information. Students listened to the text for the second time. They focused on details and what they did not understand during the first listening phase. They wrote down more detailed information and answered the questions presented in the book. Then, they discussed their answers and the text in more detail.	Inferencing Elaboration Grouping Transfer Imagery Repetition Resourcing Note- taking	Monitoring Problem-solving Evaluation Problem-identification	Self-encouragement Cooperation Questioning-for clarification

Table 4.

While-Listening Stage Activities, Third Stage

Third Listen: Third Verification Stage	Strategies		
Pedagogical Sequence	**Cognitive**	**Metacognitive**	**Affective**
Students listened for information that they had not been able to decipher earlier in the class discussion. Students listened to the text for the third time to verify their understanding and get the information they might have missed. After listening, students worked on the focused listening exercises. They attempted to personalize what they had learned by creating stories related to the topic using vocabulary, phrases, and structures presented in the passage.	Summarization Translation Transfer Repetition Elaboration Inferencing	Selective-attention Monitoring Problem-identification	Self-encouragement Cooperation Questioning-for clarification

Table 5.

Activities in Post-Listening Stage

Reflection Stage	Strategies		
Pedagogical Sequence	**Cognitive**	**Metacognitive**	**Affective**
Students reflected on the results of the decision-making process during the listening task, identifying what went well, what went wrong, and what could be done differently. Students reflected on their experience in the listening activity and evaluated the effectiveness of cognitive strategies used and the results of decisions made during the task. Students shared their ideas regarding the approach they have taken. They also discuss what other strategies they will use for the next listening task.	Imagery Transfer Elaboration	Evaluation Problem-identification	Cooperation Taking-emotional-temperature Questioning-for-clarification

3.4.2 Cognitive Load Effects (Chen et al., 2017). In addition to the model mentioned above, the study material was presented in light of CL effects, as outlined by Chen et al. (2017). Using the cognitive-load decreasing material, students could choose whether they needed to access the strategy battery in general, the strategies that might be used for each question, and the examples or definitions of those strategies for each question (Table 6).

Table 6.

Cognitive Load Decreasing Effects on Study Materials (Adopted from Chen et al., 2017)

Goal-free effect: Students used the given information at all or not, or used any of the number of given strategies, or chose the ones they found suitable independently, so they were not following a fixed sequence. They were presented with open-ended tasks rather than goal-specific activities. **Worked example effect:** Students had access to examples of strategies if needed. Examples for doing exercises guide them. **Completion problems:** Students could use previously specified strategies to complete the exercise. They were given completion exercises.

Split-attention effect: Students had access to the complete battery of strategies, including those applicable to each question, along with their corresponding example sentences and definitions.

Redundancy effect: Students could choose to use the available strategy files or not. So the existence of redundant terminologies, definitions, and examples might not exceed students' load.
Modality and the transient information effect: Students had access to the written format of the complete battery of strategies, including the strategies applicable to each question, as well as example sentences and definitions, as the teacher read and explained them. So the visual and auditory channels were integrated.
Imagination effects: the inclusion of an example guided students to imagine and visualize the application of strategies.
Isolated element and element interactivity effect: Students accessed an element of strategies in isolation, including terminology, definitions, and examples for each question, and, if needed, accessed the whole.
Respecting the expertise reversal and the guidance fading effect: The presence of strategies in their material was not in a fixed linear manner, and disappeared little by little as students gained enough expertise. Initially, definitions were provided, followed by examples. Finally, the terminology was eliminated to allow students to feel autonomous and responsible for selecting the appropriate strategy for each question. From the very beginning, each student had the authority to use the available information in the text or not.

3.5. Procedure

The teacher, who was one of the researchers, administered the GPT, GLT, and CL questionnaires to the groups before the treatment. The participants attended 16 sessions, meeting once a week for 180 minutes each. In the experimental groups, the teacher prepared and distributed learning materials based on CL effects and a metacognitive pedagogical sequence to students at every session. The teacher revised the materials to match the learners' skill levels each session. Reflection papers and oral strategy assessments provided feedback to prepare the materials for the next session. Based on this feedback, the teacher adjusted the amount of explicit oral instruction before the listening tasks and the level of scaffolding in the materials for each session. Following Chamot (2004), the teacher then switched from using L1 to L2 for instruction and decreased the explicit teaching of strategies. She focused on providing multiple practice opportunities to ensure that students internalized the strategies and could transfer them to other contexts.

The SB-CLD-CBM group had access to the electronic version of the study materials (Appendix A). Through these materials, implementing CL effects was more promising. Students had access to the strategies (definitions and examples) needed for each listening activity. They could make necessary adjustments based on their needs and use or remove any part of the information they desired. The teacher followed Cross's (2009) model of strategy instruction, which is designed explicitly for technology-integrated instruction. This model combines the use of specific listening strategies with audiovisual technology to encourage ameliorating listening comprehension for students.

Table 7.

Model of Strategy (Cross, 2009)

Instruction Model Using Technology Materials
Identify and analyze factors that may influence the extent of comprehension.
Expose learners to the material and ascertain whether or not they already apply any listening strategies.
Determine suitable metacognitive, cognitive, and social-affective strategies for instruction and consider appropriate activities through which to teach them.
Prepare pre-listening, while listening, and post-listening materials and exercises.
Conduct integrated and informed strategy instruction, provide substantial practice and feedback, and consistently review.
Evaluate the learner instruction regularly and revise where necessary.
Encourage self-evaluation and autonomous use of listening strategies.

Accordingly, during the first sessions, when students were not yet adept at using strategies, all the terminology, definitions, and examples specific to each task were available to them before each task, although the paperclip was attached. By clicking on the paper clip, they could access the required information quickly. As they gained more expertise, less information was provided. Finally, they reached a level at which no information on strategies was available, and they could transfer their learned knowledge to the new listening task.

Explicit strategy instruction continued until the ninth session, during which students could identify which strategy was best suited for a specific listening task. The teacher focused on automating listening strategies in students' minds and removed all strategy-related terminology before each listening task. However, learners still had access to the listening strategies battery at the beginning of each lesson. They practiced strategies for one additional session, session ten, while completing a listening task. In the subsequent sessions, the learners practiced listening comprehension and strategies without access to the battery.

SB-CLD-TBM followed Rubin et al.'s (2007) model of strategy instruction. The model integrates a focus on metacognitive awareness, instruction on how strategies can be applied (through teacher presentation and modeling), the application and practice of strategies, and the evaluation and transfer of strategies (Appendix B). These elements together are at the heart of successful strategy instruction.

Table 8.

Model of Strategy Instruction (Rubin et al., 2007)

Increasing students' awareness of the strategies they were using.
Presenting and modeling strategies to help learners become aware of their own thinking and learning processes.

Providing several practice opportunities to help students use the strategies independently through the gradual elimination of scaffolding Self-evaluation of the usefulness of the strategies Transfer of strategies to new tasks

This group did not work through digital devices. Therefore, to incorporate the requirements of CL effects, the teacher wrote down the names of strategies that could be used for each listening task. She included the definitions and examples of the strategies used for each task on the page. Accordingly, the teacher prepared the materials for each session and handed them out to the students. As the students' mastery of listening strategies improved, the teacher provided less information in the text.

From the beginning to the eleventh session, explicit strategy instruction continued through the provision of definitions, examples, and applications. Students were presented with all the information about the strategies and clues for each listening task, which helped them choose the appropriate strategy. In the seventh session, students understood the definition of strategies but were unable to determine which strategy was most suitable for a specific task. Therefore, in the materials for the next session, only the titles of strategies for each specific task were provided, and instructions were solely in English. In the ninth and tenth sessions, the teacher removed strategies from the materials, requiring students to identify the appropriate strategy for each task. However, they still had access to and could use the complete set of strategies. In the following sessions, students drew on their knowledge and expertise to determine the most suitable strategy for a specific listening task.

The SB-NCLD-CLM group, like the two other groups, was taught the listening sections of *Passages One* (Richards & Sandy, 2014) as their study material and covered 12 chapters. They received the standard instructional sequence of the book (pre-listening, while-listening, and post-listening). However, no explicit mention of listening strategies, scaffolding, or support in this vein, or any other areas, such as extra visual cues, glossaries, or supplementary material, was provided. Strategy instruction was carried out implicitly through the textbook-provided tasks, following Vandergrift and Tafaghodtari (2010) approach, known as the Metacognitive Pedagogical Sequence (Table 9). The sequence employs a holistic approach, providing an implicit, embedded platform for teaching listening strategies through task performance. In this group, the teacher led the students in learning the strategies without explicitly mentioning their definitions and examples. However, cognitive load principles were not included in their study material. This design enabled the SB-NCLD-CLM group to serve as a baseline for evaluating the impact of cognitive load-decreasing strategy-based lessons implemented in the experimental conditions.

Table 9.

Metacognitive Pedagogical Sequence

Pedagogical Stages	Metacognitive Processes
Pre-listening: Planning/ Prediction Stage After students are informed about the topic and text type, they predict the types of information and possible words they may hear.	Planning and directing attention
First Listen: First Verification Stage Students verified their initial hypotheses, making corrections as required, and noted any additional information they understood. Students compared what they understood/wrote with their peers, modified as required, identified what needed resolution, and decided on the important details that required special attention.	Elective attention, monitoring, and evaluation
Second Listen: Second Verification Stage Students' points of earlier disagreement, make corrections, and write additional details that are understood. Class discussion in which all class members contribute to the reconstruction of the text's main point and most pertinent details, interspersed with reflections on how students arrived at the meaning of certain words or parts of the text.	Selective attention, monitoring, evaluation, and problem solving Monitoring, evaluation, and problem-solving
Third Listen: Final Verification Stage Students listen specifically for the information revealed in the class discussion, which they were not able to decipher earlier.	Selective attention, monitoring, and problem solving
Reflection Stage Based on earlier discussion of strategies used to compensate for what was not understood, students write goals for the next listening activity.	Evaluation and planning

The participants retook the GLT during the fourteenth session. Two weeks later, they took the LAT (the unseen listening test) to allow the researchers to examine their achievement and control the threat of practice effect, which could occur with the second administration of GLT. The researchers also assessed the participants' CL.

Students in SB-CLD-CBM and SB-CLD-TBM classes completed a reflection paper every other session based on their experiences with the listening task. The reflection papers focused on students' perception of CL and were used only in the experimental groups who were instructed based on cognitive load-decreasing materials.

4. Results

4.1. Research Question One

The skewness indices (obtained by dividing the statistic by the standard error) ensured that the distribution of scores was normal, as they fell within the range of ±1.96 (Table 10).

Table 10.

Descriptive Statistics for Pretest (GPT, GLT) and Posttest (GLT and LAT)

Test	Group	N	Mean	SD.	Skewness Statistic	Std. Error
GPT	SB-CLD-CBM	29	118.28	5.713	-.180	.434
	SB-CLD-TBM SB-NCLD-CLM	31	116.77	5.993	.243	.434
		28	116.96	6.432	.424	.441
GLT	SB-CLD-CBM	29	14.59	.780	-.550	.434
	SB-CLD-TBM	31	14.87	.991	-.165	.421
	SB-NCLD-CLM	28	14.50	.923	.304	.441
GLT (posttest)	SB-CLD-CBM	29	20.21	1.840	.154	.434
	SB-CLD-TBM	31	19.32	1.851	-.306	-.421
	SB-NCLD-CLM	28	16.68	1.786	-.189	.441
LAT	SB-CLD-CBM	29	20.45	2.339	-.281	.434
	SB-CLD-TBM	31	19.77	1.783	-.088	.421
	SB-NCLD-CLM	28	16.82	1.679	-.355	.441

Two one-way ANOVAs were conducted on English language proficiency (GPT) and listening skills (GLT). The homogeneity of variances for GPT was confirmed ($F_{(2, 85)} = 0.33$, $p = 0.71$). Results showed that the groups did not significantly differ in GPT scores ($F_{(2, 85)} = 0.53$, $p = 0.58$). The homogeneity of variances for GLT was also verified ($F_{(2,85)} = 0.53$, $p = 0.58$). The ANOVA results also indicated no significant difference among the three groups before the treatment ($F_{(2, 85)} = 1.37$, $p = 0.25$) (Table 11).

Table 11.

One-Way ANOVA between GPT and GLT

		Sum of Squares	df	Mean Square	F	Sig.
GPT	Between Groups	39.266	2	19.633	.537	.587
	Within Groups	3108.177	85	36.567		
	Total	3147.443	87			
GLT	Between Groups	2.254	2	1.127	1.37	.258
	Within Groups	69.518	85	.818		
	Total	71.773	87			

After the treatment, a MANOVA was conducted to examine differences among the

groups on two posttests (GLT and LAT). Table 12 presents the descriptive statistics.

Table 12.

Descriptive Statistics on the Two Posttests

Dependent Variable	Group	Mean	Std. Error	97.5% Confidence Interval Lower Bound	Upper Bound
GLT	SB-CLD-CBM	20.207	.339	19.433	20.981
	SB-CLD-TBM	19.323	.328	18.574	20.071
	SB-NCLD-CLM	16.679	.345	15.891	17.466
LAT	SB-CLD-CBM	20.448	.363	19.620	21.276
	SB-CLD-TBM	19.774	.351	18.973	20.575
	SB-NCLD-CLM	16.821	.369	15.979	17.664

The similarity of the post-GLT (*M*=18.77) and post-LAT (*M*=19.06) values showed that the assumption of linearity was satisfied. An examination of the assumption of multivariate outliers revealed no substantial outliers. The Mahalanobis value of 11.076 was less than the critical value. The homogeneity of variance-covariance matrices ($p < 0.001$) indicated a violation of the assumption; therefore, Pillai's Trace was used to check the results (Tabachnick & Fidell, 2013).

Regarding the assumption of multicollinearity, the significant value ($p < 0.001$) indicated a positive correlation between GLT and LAT. The assumption of normality of variances was satisfied for GLT: ($F_{(2, 85)} = .023$, $p = 0.97$); LAT: ($F_{(2, 85)} = 1.38$, $p = 0.25$).

The MANOVA results (Table 13) revealed a statistically significant difference between groups on GLT and LAT, $F_{(4,170)} = 11.60$, $p < .001$; Pillai's Trace=.42; ηp2=.21.

Table 13.

Multivariate Tests for GLT and LAT Posttest

Effect		Value	F	Hypothesisdf	Error df	Sig.	Partial Eta Squared ηp^2
Intercept	Pillai's Trace	.991	4591.410b	2.000	84	.000	.991
	Wilks' Lambda	.009	4591.410b	2	84	.000	.991
	Hotelling's Trace	109.319	4591.410b	2	84	.000	.991
	Roy's Largest Root	109.319	4591.410b	2	84	.000	.991
Group	Pillai's Trace	.429	11.599	4	170.	.000	.214
Wilks' Lambda		.579	13.188b	4	168	.000	.239
Hotelling's Trace		.713	14.792	4	166	.000	.263
Roy's Largest Root		.693	29.452c	2	85	.000	.409

When the results for GLT and LAT were examined separately (Table 14), using a Bonferroni adjustment with an alpha level of 0.25, a statistically significant difference was identified in post-GLT ($F_{(2, 85)}$ = 28.74, p < 0.001; ηp2 =.40) and post-LAT ($F_{(2,85)}$ = 27.75, p < 0.001; ηp2 = .39).

Table 14.

Tests of Between-Subject Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared η^2_p
Corrected Model	LAT	191.815a	2	95.907	28.741	.000	.403
	GLT	212.017b	2	106.008	27.751	.000	.395
Intercept	LAT	30836.381	1	30836.381	9240.914	.000	.991
	GLT	31760.313	1	31760.313	8314.246	.000	.990
Group	LAT	191.815	2	95.907	28.741	.000	.403
	GLT	212.017	2	106.008	27.751	.000	.395
Error	LAT	283.640	85	3.337			
	GLT	324.699	85	3.820			
Total	LAT	31488.000	88				
	GLT	32495.000	88				
Corrected Total	LAT	475.455	87				
	GLT	536.716	87				

a. R Squared = .403 (Adjusted R Squared = .389)
b. R Squared = .395 (Adjusted R Squared = .381)

The Bonferroni test (Table 15) showed a statistically significant difference between SB-CLD-CBM and SB-NCLD-CLM (p < 0.001, 95%, CI = 2.22 to 4.84) and between SB- CLD-TBM and SB-NCLD-CLM (p < 0.001, 95%, CI = 1.36 to 3.93) in GLT. However, no statistically significant differences were observed between the two groups. Regarding LAT, a statistically significant difference was also detected between SB-CLD-CBM and SB-NCLD-CLM (p < 0.001, 95%, CI = 2.23 to 5.03) and between SB-CLD-TBM and SB- NCLD-CLM (p < 0.001, 95%, CI = 1.58 to 4.33).

Table 15.

Bonferroni Post Hoc Multiple Comparisons

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	97.5% Confidence Interval Lower Bound	Upper Bound
GLT	SB-CLD-CBM	SB-CLD-TBM	.88	.472	.193	-.39	2.16
		SB-NCLD-CLM	3.53*	.484	.000	2.22	4.84
	SB-CLD-TBM	SB-CLD-CBM	-.88	.472	.193	-2.16	.39

		SB-NCLD-CLM	2.64*	.476	.000	1.36	3.93
	SB-NCLD-CLM	SB-CLD-CBM	-3.53*	.484	.000	-4.84	-2.22
		SB-CLD-TBM	-2.64*	.476	.000	-3.93	-1.36
LAT	SB-CLD-CBM	SB-CLD-TBM	.67	.505	.556	-.69	2.04
		SB-NCLD-CLM	3.63*	.518	.000	2.23	5.03
	SB-CLD-TBM	SB-CLD-CBM	-.67	.505	.556	-2.04	.69
		SB-NCLD-CLM	2.95*	.510	.000	1.58	4.33
	SB-NCLD-CLM	SB-CLD-CBM	-3.63*	.518	.000	-5.03	-2.23
		SB-CLD-TBM	-2.95*	.510	.000	-4.33	-1.58

4.2. Research Question Two

The researchers compared the groups using data from the CLT questionnaire. The skewness indices (Table 16) ranged between ±1.96, verifying the normality assumption.

Table 16.

Descriptive Statistics of the Scores Distribution

Test	Group	N	Mean	SD.	Skewness Statistic	Std. Error
CL (pretest)	SB-CLD-CBM	29	333.4	96.3	-.543	.434
	SB-CLD-TBM	31	318.0	130.3	-.555	.421
	SB-NCLD-CLM	28	303.9	85.4	-.448	.441
CL (posttest)	SB-CLD-CBM	29	235.5	81.4	.428	-.434
	SB-CLD-TBM	31	225.8	111.9	-.031	.421
	SB-NCLD-CLM	28	307.5	88.1	-.436	.441

The test for homogeneity of variances on cognitive load revealed that the assumption of homogeneity of variances was violated ($F_{(2, 85)} = 3.26$, $p = 0.43$). The ANOVA (Table 17) revealed no statistically significant difference in CL scores among the groups ($F_{(2, 85)} = 0.54$, $p = 0.58$). Welch and Brown-Forsythe tests corroborated the finding by showing no statistically significant difference between the groups (Welch: $p = 0.48$; Brown-Forsythe: $p = 0.57$).

Table 17.

One-way ANOVA for CL

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	12429.463	2	6214.732	.546	.581
Within Groups	966806.901	85	11374.199		
Total	979236.364	87			

The homogeneity of variances was violated for CL ($F_{(2, 85)} = 4.35$, $p = 0.01$). One- way

ANOVA (Table 18) indicated a statistically significant difference in the groups' CL scores ($F_{(2, 85)} = 6.31$, $p < 0.003$).

Table 18.

One-way ANOVA for CL

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	114602.920	2	57301.460	6.316	.003
Within Groups	771197.080	85	9072.907		
Total	885800.000	87			

The results of the Welch and Brown-Forsythe tests supported the finding, showing a statistically significant difference between the groups (Welch: $p < 0.002$ and Brown-Forsythe: $p < 0.003$). Table 19 shows a statistically significant difference between SB-NCLD-CLM and SB-CLD-CBM ($p = 0.02$, 95%, CI = 9.10 to 134.8) and SB-NCLD-CLM and SB-CLD-TBM ($p = 0.006$, 95%, CI = 19.82 to 143.5). However, no statistically significant differences were shown between the SB-CLD-CBM and SB-CLD-TBM groups.

Table 19.

Scheffé Post Hoc Comparisons

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
SB-CLD-CBM	SB-CLD-TBM	9.711	24.608	.925	-51.60	71.02
	SB-NCLD-CLM	-71.983*	25.237	.021	-134.86	-9.10
SB-CLD-TBM	SB-CLD-CBM	-9.711	24.608	.925	-71.02	51.60
	SB-NCLD-CLM	-81.694*	24.834	.006	-143.57	-19.82
SB-NCLD-CLM	SB-CLD-CBM	71.983*	25.237	.021	9.10	134.86
	SB-CLD-TBM	81.694*	24.834	.006	19.82	143.57

4.3. Research Question Three

Students submitted their reflection papers almost simultaneously after receiving the treatment. The analysis revealed that the responses followed a consistent pattern in both the SB-CLD-CBM and SB-CLD-TBM groups, with indications of CL among students from the first to the final session. Nearly half of the students experienced CL in all sessions for three reasons: lack of knowledge and understanding, lack of concentration, and sequential classes.

The first theme, *lack of knowledge and understanding*, emerged as the most common response in this category. Students primarily felt pressure due to their inability to grasp the material and keep pace with the course. Some students expressed that the listening was too fast, while others felt their vocabulary was not extensive enough for complete comprehension. Some excerpts are: "I have a problem hearing the correct

pronunciation of words." Or, "I couldn't understand some parts, and I had to put pressure on my mind to understand." Or, "When I cannot understand a word in a sentence, I feel pressure."

The second theme, "*lack of concentration,*" indicated that listening was a mentally demanding activity that required great concentration and attention. The participants believed that one momentary lapse in their engagement could lead to a total loss of listening, as the comments illustrate: "This class needs much concentration, and if you miss a part, you cannot understand the rest." Or, "I couldn't concentrate."

The third extracted theme, "*sequential classes*," highlighted the role of extraneous factors in the learning procedure. For some students, it was not the listening process or the task itself that required more cognitive involvement; instead, they identified the long hours of classes and successive schedules as the factors that placed them under pressure: "I had many classes before this class."

5. Discussion

Findings related to the first research question revealed that the SB-CLD-CBM and SB-CLD-TBM groups performed better in listening comprehension than the SB-NCLD-CLM group. However, no differences were found between the SB-CLD-CBM and SB-CLD-TBM groups, which can be explained by considering the critical role of WM capacity in processing listening input. WM capacity is limited and cannot function effectively when new information consists of multiple elements (Sweller, 2023) with varying durations (Xie et al., 2020). By adhering to the principles of CLT (Chen et al., 2017), the study materials for these groups enabled students to allocate cognitive resources effectively and maintain adequate processing capacity. The materials helped learners remain mentally alert to relevant information and avoid irrelevant, cognition-consuming details. Consequently, they could utilize their WM capacity more effectively. This finding aligns with Chen et al. (2017), who suggested that less-skilled learners struggle to grasp relevant information while listening; thus, they feel overwhelmed by the significant amount of information, a phenomenon referred to as the narrow limits of change principle in CLT. Listening inefficiency results from the limitations and failures of L2 learners' memory and cognitive systems (Goh, 2023; Satori, 2021). Thus, using appropriate materials can reduce the load on WM and lead to successful listening performance.

The finding aligns with studies that emphasize the importance of listening strategies in developing a skilled listener who can effectively coordinate and synchronize various strategies (Goh & Vandergrift, 2021; Vandergrift & Cross, 2018). In this vein, the researchers

postulate that through listening strategies, students are empowered to control their comprehension process in various listening tasks and manage multiple sources of information and interacting elements simultaneously, resulting in a lower cognitive load. Goh and Vandergrift (2021) argued that through cognitive strategies, students form mental connections with the input by creating mental images or applying their previously learned skills and concepts.

The findings also receive support from cognitive theories of listening, such as Baddeley's (2000) model of WM and the connectionist model (Bechtel & Abrahamsen, 1991). Cognitive theories share fundamental principles regarding WM and cognitive processing capacity. Firstly, learners should attend to the input to process information and decode the signals. They should recognize words and break them into meaningful units simultaneously. This process happens automatically for skilled learners, while less-skilled learners must engage in controlled information processing. These factors underscore the importance of strategy instruction in helping learners quickly recognize and parse input, which was the primary goal of this study. Strategy-based, cognitive-load-decreasing materials helped learners actively listen, constantly manage and regulate their thinking processes, and allocate their cognitive resources for upcoming information.

The lack of differences between the SB-CLD-CBM and SB-CLD-TBM groups verifies earlier findings in this respect, which hold that the human cognitive system processes information regardless of whether the material is presented digitally or in hard copy form. More specifically, in line with Chen et al. (2017), this study shows that WM and long-term memory function similarly in both modes of presentation. Similar studies on receptive skills contradict this finding, as Macedo-Rouet et al. (2003) found that hypertext reading leads to greater comprehension than hard copy. They showed that material provided through computers enhanced learners' perceived CL. Unlike this study, Genç and Gulozer (2013) also found that presenting reading material through hypertext enhances comprehension and promotes students' success.

The answer to the second research question highlighted two issues: first, the SB-CLD-CBM and SB-CLD-TBM groups experienced lower CL than the SB-NCLD-CLM group. Second, no difference existed in CL between the SB-CLD-CBM and SB- CLD-TBM groups. The first issue, the lower CL scores of SB-CLD-CBM and SB-CLD- TBM compared to the SB-NCLD-CLM, can be explained by CLT (Paas & Merrienboer, 2020), the strategy mediation hypothesis (Dunning & Holmes, 2014; Peng & Fuchs, 2017), and the cognitive-affective motivation learning model (McGrew, 2022). Referring to CLT, Sweller (2020, 2023) specified three types of CLs: intrinsic, extrinsic, and germane. The underlying assumption was that for optimal learning conditions, instructional material must be presented in a way

that (1) controls the intrinsic load (e.g., through managing element interactivity and providing earlier information to learners), (2) lessens extraneous cognitive load (e.g., by eliminating learning-irrelevant data), and (3) ensures that cognitive resources to manage both loads are accessible (e.g., by encouraging learners to engage in the activity). Thus, studies in this field focus more on redesigning instructional materials and methodologies to meet the criteria for reducing cognitive load (Sweller, 2020, 2023). Accordingly, the researchers of the current study assume that the study materials helped students maintain enough mental capacity to stay on track, focus on relevant information, address discrepancies and knowledge gaps, process their previous schemas quickly, and manage input without being overwhelmed by large amounts of information. In other words, in line with Chen et al. (2017), the tailored materials controlled intrinsic CL and provided students with shortcuts to navigate the barriers they faced while listening. By using appropriate materials, teachers may decrease learners' cognitive load and enhance their engagement in learning (Dong et al., 2020).

The findings of this study can also be explained by the strategy mediation hypothesis (Dunning & Holmes, 2014; Peng & Fuchs, 2017), which proposes that through adequate WM exercise, it is possible to modify the choice strategies for a specific task. This modification yields improved performance on both trained and untrained tasks (Dunning & Holmes, 2014). The hypothesis assumes that practice-generated differences in WM are provided by compensatory strategies that learners develop during practice (Peng & Fuchs, 2017). Accordingly, in this study, students' WM was enhanced through continuous practice of listening strategies, allowing them to employ appropriate strategies for completing listening tasks. They automatically utilized a task-specific strategy that facilitated their performance and reduced cognitive load. Likewise, Goh (2023) believed that through adequate training, listening strategies can be expected to develop into well-structured, automatized listening skills over time. Learners will continually move between skills and strategies while listening to various forms of discourse with different levels of challenge, as competent listeners sometimes must do.

The findings of this study also support McGrew's (2022) cognitive-affective motivation learning model. He believed motivation, affective factors, and cognitive constructs should be integrated into an optimal learning model. Accordingly, in this study, cognitive load theory principles and listening strategies simultaneously provided the SB-CLD-TBM and SB- CLD-CBM students with both affective and cognitive support to accomplish the learning task.

Regarding the second point, which indicated no significant difference between the SB-CLD-CBM and SB-CLD-TBM groups in cognitive load, the researchers, in line with Chen et al. (2017), believe that the cognitive system exhibits an identical pattern in processing

information, regardless of whether the information is presented digitally or in hard copy format. The existing research reveals that no specific study has focused on the variables examined in this study. However, related studies indicate that the findings of the present study align with those of Chevalère et al. (2021), who investigated differences in inquiry- based learning and Computer-Assisted Instruction. They defined inquiry-based learning as a different approach in which students are encouraged to interact with one another in the classroom. They demonstrated that students with higher working memory capacity learn more effectively through computers. Chang et al.'s (2017) study showed that outdoor ubiquitous learning is more effective than indoor computer-assisted group learning.

To investigate the third research question, the researchers analyzed the reflection papers, which confirmed the quantitative findings, indicating that the SB-CLD-CBM and SB-CLD-TBM groups shared similar views on CL. Thus, working with digital instruments or using a traditional paper format made no difference in CL. Furthermore, half of the students reported experiencing CL up to the final session due to several factors, including a lack of knowledge and understanding, insufficient concentration, and the sequential nature of the classes.

Lack of knowledge and understanding was the most problematic factor in creating CL. This finding broadly supports CLT and assumes that more knowledgeable learners experience less intrinsic CL (Sweller et al., 2019). However, contradictory results from the theory, as well as partially from the current study, have been detected in the literature. For example, Endres et al. (2022) argued that the reverse is relatively accurate in some circumstances, including complex systems (ecological systems). They believed that amateur learners underestimate the issue's complexity, resulting in a lower intrinsic load. In the current study, students repeatedly reported that they could not follow the track because the listening appeared too fast to them, or they lost the track when they could not understand a single word, which led to a total loss of comprehension. What becomes evident by examining students' responses to the researchers' question is that, apart from mastering the language, which facilitates understanding and promotes a peaceful state of mind and a lower cognitive load, it is necessary to employ listening strategies. The reported problems of speed and lack of vocabulary knowledge are factors that could be compensated for using relevant listening strategies (Vandergrift & Cross, 2018). This issue highlights the role of language educators in employing strategic teaching in their programs.

The second item affecting cognitive load was the lack of concentration. In line with Purwanto et al.'s study (2021), the participants reported that they often became distracted. If they lost their focus for even a moment, they missed the entire listening excerpt. The participants' comments indicated that approaching an enormous listening task might result

in missing some parts of the content. In such situations, listening strategies can be helpful (Goh & Vandergrift, 2021). For instance, by employing the elaboration strategy, learners can draw on prior knowledge outside the listening text and connect it to the information acquired from the material to infer missing details. Integrating principles from CLT might be one solution to this issue. Teachers should create a setting in which students have sufficient mental capacity to process new information and apply previously learned knowledge, such as listening strategies, to manage listening challenges, including distractions and a lack of concentration.

The second inference from the students' notes is that they became distracted by irrelevant factors while listening, which reflected the underlying assumptions of CLT. Providing optimal learning conditions through appropriate instructional design can eliminate learning-irrelevant information (Sweller, 2020). Therefore, if students encounter instructional materials intentionally designed to align with the human cognitive structure, including WM and CL effects, the issue of distraction by irrelevant factors might be mitigated. However, this issue is controversial. One group of scholars believes that CL utilizes executive resources that are available for attentional management; thus, CL decreases disturbance. Conversely, another group states that CL demands high levels of concentration, which leads to reduced peripheral processing and decreased distraction.

The next influential factor was sequential classes. The students argued that their inefficiency in the listening class was due to attending too many other classes, which left them exhausted and prevented them from fully engaging mentally in the task. The participants identified cognitive-load-increasing factors, as identified in NASA-TLX, showing consistency between the quantitative and qualitative findings. For example, they mentioned mental demands when they stated that a lack of knowledge, understanding, and focus hindered their success in the task.

6. Conclusion

This study demonstrated that CL is a crucial factor in listening comprehension, and neglecting its impact can prevent teachers and students from reaching their full potential in listening activities. Students' mental capacity is a key concern; by applying CL principles in the design of learning materials, educators can help learners filter out irrelevant information from their cognitive resources, enabling them to achieve goals and complete tasks. The current research emphasizes the importance of teachers' understanding of the comprehension process and how it is accomplished. To support students effectively, teachers should identify the factors that influence this process. They need to understand

that, like other aspects of language learning, students' listening comprehension can be enhanced through carefully planned activities and learning resources. The findings provide valuable insights for teachers and materials developers to incorporate principles of CLT into instructional design. CLT, grounded in our understanding of human cognitive architecture, provides an integrated framework for developing practical learning principles in any educational setting. By offering guidelines for creating successful learning experiences, the theory can also help identify some instructional shortcomings.

Although the researchers attempted to minimize the study's flaws, some limitations remain. First, the CL questionnaire was assessed based on the respondents' self-reports. Second, students' subjective responses to the qualitative questions might not be precise. Further research on three kinds of cognitive load (germane, intrinsic, and extraneous) can elucidate the underlying factors that affect the process of listening comprehension. This study can be illuminating in research that focuses on learners' mental processes in language learning. The researchers suggest integrating teaching language skills while decreasing CL.

References

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417–423. https://doi.org/10.1016/S1364-6613(00)01538-2

Bechtel, W., & Abrahamsen, A. (1991). *Connectionism and the mind: An introduction to parallel processing in networks.* Blackwell.

Best, J. W., & Kahn, J. V. (2006). *Research in education* (10th ed.). Pearson.

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research.* Houghton Mifflin.

Chamot, A. (2004). Issues in language learning strategy research and teaching. *Electronic Journal of Foreign Language Teaching*, *1*(1), 14–26.

Chang, C. C., Lei, H., & Tseng, J. S. (2014). *Do English listening outcome and cognitive load change for different media delivery modes in u-learning?* International Association for the Development of the Information Society.

Chen, L., Huang, T-W., & Chen, Y-H. (2017). The effects of inquiry-based information literacy instruction on memory and comprehension: A longitudinal study. *Library & Information Science Research, 39*(4), 256–266. https://doi.org/10.1016/j.lisr.2017.11.003

Chen, O., Paas, F., & Sweller, J. (2023). A cognitive load theory approach to defining and measuring task complexity through element interactivity. *Educational Psychology Review, 35*, Article 63. https://doi.org/10.1007/s10648-023-09782-w

Diao, Y., Chandler, P., & Sweller, J. (2007). The effect of written text on comprehension of spoken English as a foreign language. *The American Journal of Psychology, 120*(2), 237–261. https://doi.org/10.2307/20445397

Dong, A., Jong, M., & King, R. (2020). How does prior knowledge influence learning engagement? The mediating roles of cognitive load and help-seeking. *Frontiers in Psychology, 11*, 1–10, Article 591203. https://doi.org/10.3389/fpsyg.2020.591203

Dunning, D. L., & Holmes, J. (2014). Does working memory training promote the use of strategies on untrained working memory tasks? *Memory & Cognition, 42*(6), 854– 862. https://doi.org/10.3758/s13421-014-0410-5

Endres, T., Lovell, O., Morkunas, D., Rieß, W., & Renkl, A. (2022). Can prior knowledge increase task complexity?–cases in which higher prior knowledge leads to higher intrinsic cognitive load. *British Journal of Educational Psychology*, *93*(S2), 305– 317. https://doi.org/10.1111/bjep.12563

Field, J. (2008). *Listening in the language Classroom*. Cambridge University Press.

Ghalandar-Zehi, B., Rahmanpanah, H., & Mohseni, A. (2024). Exploring inner voice in the EFL classroom: From materials development perspective. *Curriculum Research, 5*(4), 1–25. https://doi.org/https://doi.org/10.71703/cure.2024.1130467

Genç, H., & Gulozer, K. (2013). The effect of cognitive load associated with instructional formats and types of presentation on second language reading comprehension performance. *The Turkish Online Journal of Educational Technology, 12*(4), 171– 182.

Goh, C., & Vandergrift, L. (2021). *Teaching and learning second language listening: Metacognition in action.* Routledge. https://doi.org/10.4324/9780429287749

Goh, C. C. (2023). Learners' cognitive processing problems during comprehension as a basis for L2 listening research. *System*, *119*, Article 103164.

Haghighi, M., Rashtchi, M., & Birjandi, P. (2019). Exploring the role of strategic knowledge and strategic regulation in Iranian EFL learners' listening performance: A structural equation modeling approach. *Journal of Language and Translation, 9*(3), 121–136. https://dorl.net/dor/20.1001.1.20088590.2019.9.3.9.1

Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In P.A. Hancock & N. Meshkati (Eds.), *Human mental workload* (pp.139–183). North- Holland. https://doi.org/10.1016/S0166-4115(08)62386-9

He, L., & Jiang, Z. (2020). Assessing second language listening over the past twenty years: A review within the socio-cognitive framework. *Frontiers in Psychology, 11*, Article 2123.

Jiang, D. (2024). Cognitive load theory and foreign language listening comprehension. Springer.

Katz-Buonincontro, J. (2024). Convergent mixed methods designs. In J. Katz- Buonincontro (Ed.), *How to mix methods: A guide to sequential, convergent, and experimental research designs* (pp.73–82). American Psychological Association. https://doi.org/10.1037/0000404-005

Leahy, W., & Sweller, J. (2011). Cognitive load theory, modality of presentation and the transient information effect. *Applied Cognitive Psychology, 25,* 943–951. https://doi.org/10.1002/acp.1787

Lehmann, J., & Seufert, T. (2020). The interaction between text modality and the learner's modality preference influences comprehension and cognitive load. *Frontiers in Psychology. 10,* Article 2820. https://doi.org/10.3389/fpsyg.2019.02820

Liu, H., Liu, Z., Yuan, M., & Chen, T. (2024). The effect of cognitive load on code- switching. *International Journal of Bilingualism*, *28*(3), 513–530. https://doi.org/10.1177/13670069231170142

Lwande, Ch., Muchemi, L., & Oboko, R. (2021). Identifying learning styles and cognitive traits in a learning management system. *Heliyon, 7*(1), Article e07701. https://doi.org/10.1016/j.heliyon.2021.e07701

Macedo-Rouet, M., Rouet, J.-F., Epstein, I., & Fayard, P. (2003). Effects of online reading on popular science comprehension. *Science Communication, 25*(2), 99–128. https://doi.org/10.1177/1075547003259209

Macaro, E. (2001). Analysing student teachers? Code switching in foreign language classrooms: Theories and decision making. *The Modern Language Journal, 85*(4), 531–548. https://doi.org/10.1111/0026-7902.00124

Mackey, A., & Gass, S. M. (2021). *Second language research: Methodology and design (3rd ed.)*. Routledge. https://doi.org/10.4324/9781003188414

Masrai, A. (2020). Exploring the impact of individual differences in aural vocabulary knowledge, written vocabulary knowledge and working memory capacity on explaining L2 learners' listening comprehension. *Applied Linguistics Review, 11*(3), 423–447.

McGrew, K. S. (2022). The cognitive-affective-motivation model of learning (CAMML): Standing on the shoulders of giants. *Canadian Journal of School Psychology, 37*(1), 117–134. https://doi.org/10.1177/08295735211054270

McNamara, D. S., & Scott, J. L. (2001). Working memory capacity and strategy use. *Memory & Cognition, 29*(1), 10–17. https://doi.org/10.3758/BF03195736

Moussa-Inaty, J., Ayres, P., & Sweller, J. (2012). Improving listening skills in English as a foreign language by reading rather than listening: A cognitive load perspective. *Applied Cognitive Psychology, 26*(3), 391–402. https://doi.org/10.1002/acp.1840

Nilforoushan, S., Rashtchi, M., & Abbasian, Gh. (2024). The role of text type on the use of metacognitive reading strategies: Iranian EFL learners' perceptions in focus. *Curriculum Research, 5*(1), 99–120. https://doi.org/https://doi.org/10.71703/cure.2024.1107725

Paas, F., & Van Merrienboer, J.J.G. (2020). Cognitive load theory: Methods to manage working memory load in the learning of complex tasks. *Current Directions in Psychological Science, 29*(4), 394–398. https://doi.org/10.1177/0963721420922183

Peng, P., & Fuchs, D. (2017). A randomized control trial of working memory training with and without strategy instruction: Effects on young children's working memory and comprehension. *Journal of Learning Disabilities, 50*(1), 62–80. https://doi.org/10.1177/0022219415594609

Purwanto, D., Fadhly, F.Z., & Rahmatunisa, W. (2021). Listening comprehension study: Difficulties and strategies used by college students. *Indonesian Journal of Learning and Instruction, 4*(1), 55–62. https://doi.org/10.25134/ijli.v4i1.4345

Retnowati, R., Suharyati, H., Manurung, R., Maknun, D., Armariena, D. N., Hetilaniar, H., Hasanudin, C., Murniviyanti, L., Anwar, S., & Setyorini, R. (2018). The Effect of environmental teaching method and the level of natural intelligence on the environmental view of the students' behavior. *Journal of Physics: Conference Series, 1114*(1), 1–7, Article 012104. https://doi.org/10.1088/1742- 6596/1114/1/012104

Richards, J. C., & Sandy, C. (2014). *Passages level 1 student's book.* Cambridge University Press.

Rubin, J., Chamot, A. U., Harris, V., & Anderson, N. J. (2007). Intervening in the use of strategies. In A. Cohen & E. Macaro (Eds.), *Language learner strategies: Thirty years of research and practice* (pp. 141–160). Oxford University Press.

Satori, M. (2021). Effects of working memory on L2 linguistic knowledge and L2 listening comprehension. *Applied Psycholinguistics, 42*(5), 1313–1340. https://doi.org/10.1017/S0142716421000345

Sayyadi, M. (2019). The cognitive load of listening activities of a cognitive-based listening instruction. *Indonesian Journal of Applied Linguistics, 9*(2), 202–216.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002*). Experimental and quasi- experimental designs for generalized causal inference*. Houghton Mifflin.

Subkoviak, M. (2005). Empirical investigation of procedures for estimating reliability of mastery tests. *Journal of Educational Measurement. 15*, 111–116. https://doi.org/10.1111/j.1745-3984.1978.tb00062.x

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*(2), 257–285.

Sweller, J. (2016). Cognitive load theory, evolutionary educational psychology, and instructional design. In D. C. Geary & D. B. Berch (Eds.), *Evolutionary perspectives on child development and education* (pp. 291–306). Springer. https://doi.org/10.1007/978-3-319-29986-0_12

Sweller, J. (2020). Cognitive load theory and educational technology. *Education TechnologyResearch & Development, 68*(1), 1–16. https://doi.org/10.1007/s11423-019-09701-3

Sweller, J. (2023). The development of cognitive load theory: Replication crises and incorporation of other theories can lead to theory expansion. *Educational Psychology Review, 35*(4), Article 95. https://doi.org/10.1007/s10648-023-09817-2

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer. https://doi.org/10.1007/978-1-4419-8126-4_7

Sweller, J., Van Merrienboer, J.J. G., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review, 31*(2), 261– 292. https://doi.org/10.1007/s10648-019-09465-5

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Pearson.

Vandergrift, L. (1997). The Cinderella of communication strategies: Reception strategies in interactive listening. *The Modern Language Journal*, *81*(4), 494–505. https://doi.org/10.2307/328892

Vandergrift, L. (2004). Listening to learn or learning to listen? *Annual Review of Applied Linguistics*, *24*, 3–25.

Vandergrift, L., & Cross, J. (2018). Metacognitive listening strategies. In J. I. Liontas (Eds.), *The TESOL Encyclopedia of English language teaching* (pp. 1–6). John Wiley & Sons. https://doi.org/10.1002/9781118784235.eelt0567

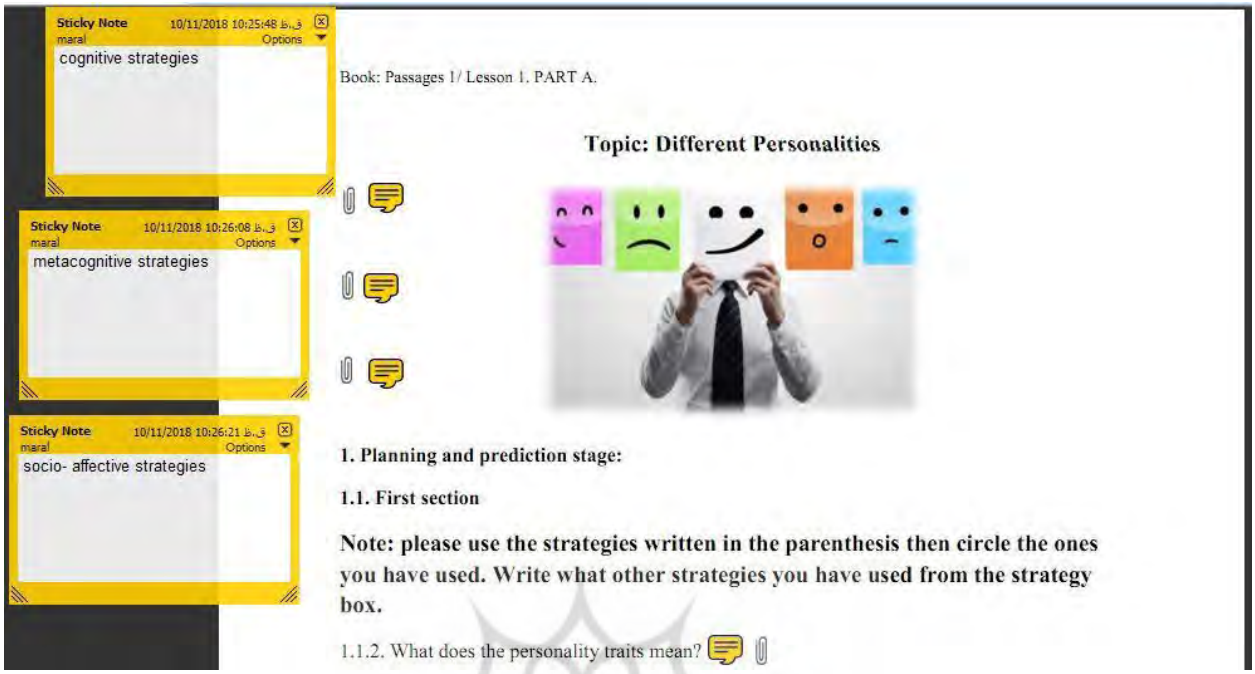
Vandergrift, L., & Goh, C. C. M. (2012). *Teaching and learning second language listening: Metacognition in action.* Routledge.

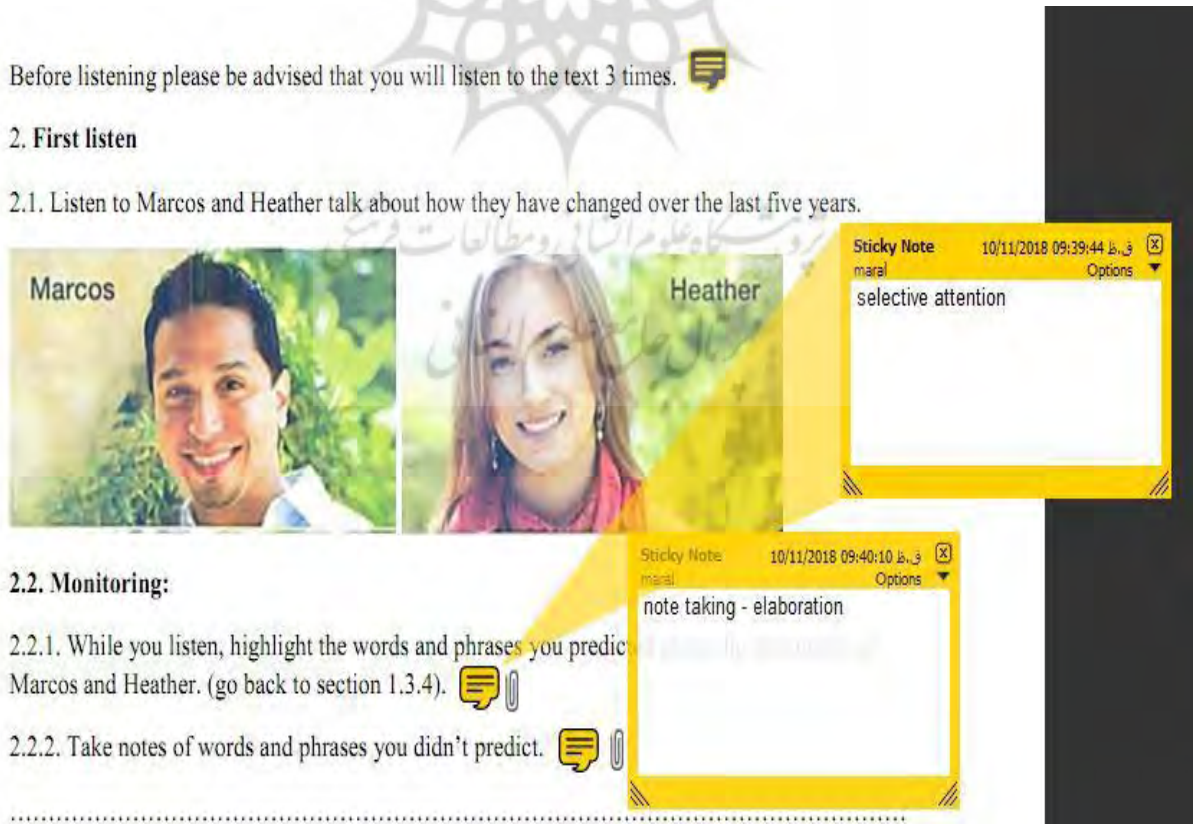
Vandergrift, L., & Tafaghodtari, M. (2010). Teaching L2 learners how to listen does make a difference: An empirical study. *Language Learning, 60*(2), 470–497. https://doi.org/10.1111/j.1467-9922.2009.00559.x

Xie, W., Campbell, S., & Zhang, W. (2020). Working memory capacity predicts individual differences in social distancing compliance during the COVID-19 pandemic in the U.S. *Proceedings of the National Academy of Sciences of the USA, 117*(30),17667–17674. https://doi.org/ 10.31234/osf.io/3j69f

Appendix A

Sample Lesson for Computer-based Instruction





Appendix B

Sample Lesson for Text-based Instruction

Topic: Different Personalities

1. Planning and prediction stage:

1.1. First section

Note: please use the strategies written in the parenthesis then circle the ones you have used. Write what other strategies you have used from the strategy box.

1.1.2. What does the personality traits mean? *(resourcing + elaboration)*

.....
.....
.....

1.1.3. Can you provide me with different personality traits you know? *(elaboration + grouping)*

.....
.....
.....

1.1.4. Search and write on a piece of paper what you have found regarding personality traits in the dictionary or internet. *(resourcing + grouping + note taking)*

Elaboration: using prior knowledge outside the text or conversational context and relating it to knowledge gained from the text or conversation in order to predict outcomes or fill in missing information

Resourcing: using available reference ources of information abut the target language, including dictionaries, textbooks,...

Grouping: Recalling information based on grouping according to common attributes

e.g., I try to relate the words that sound the same

Note-taking: writing down key words and concepts in abbreviated verbal, graphic, or numerical form to assist performance