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Cultural–Religious Challenges and Opportunities of FinTech in Financial Literacy Education for Children Aged 10–12 in Tehran

ABSTRACT

This study aimed to identify the cultural–religious challenges and opportunities of fintech in financial literacy education for children aged 10–12 in Tehran, using a qualitative approach and thematic analysis. Data were collected through semi-structured interviews with 36 participants until theoretical saturation was achieved. The results of the qualitative analysis led to the identification of 30 main themes and 119 sub-themes, aligned with the three dimensions of the OECD financial literacy model—financial knowledge, financial behavior, and financial attitudes—as well as the learning theories of Vygotsky, Piaget, and Ajzen. Key findings indicate that cultural–religious factors such as alignment with Islamic values, localization of content and instructional methods, data security and privacy, parental control, and game-based learning play a central role in the effective design and implementation of financial literacy education programs. Cohen’s kappa coefficient for most themes was calculated to be above 0.70, indicating high coding reliability. In addition, member checking was conducted with a participation rate exceeding 80%, and the feedback received was incorporated into the final analysis. This study provides a comprehensive framework for the development of localized financial literacy programs that, while adhering to international standards, are aligned with the cultural and religious values of Iranian society and can serve as a foundation for educational policymaking and digital content development in the field of children’s fintech.

Keywords: children’s financial literacy, fintech, financial education, thematic analysis, Islamic values, localization

Introduction

Over the past three decades, task-based language teaching (TBLT) has emerged as one of the most influential paradigms in second language acquisition (SLA) research and pedagogy, positioning communicative tasks at the core of language learning processes. Rooted in functional and interactionist theories of language, TBLT conceptualizes language development as an outcome of meaningful language use, problem-solving, and goal-oriented activity rather than the rote manipulation of linguistic forms. Early formulations emphasized the pedagogical value of tasks as units of instruction that mirror real-world language use and promote authentic communication, thereby aligning classroom practices with naturalistic conditions of language learning (1, 2). This orientation marked a significant shift away from traditional form-focused instruction and toward learner engagement, interaction, and experiential learning.

Central to TBLT is the notion of the task itself, commonly defined as an activity in which learners use the target language to achieve a communicative outcome, with meaning as the primary focus and success evaluated in terms of outcome rather than formal accuracy. This conceptualization has been elaborated and refined through extensive theoretical and empirical work, leading to distinctions between pedagogic and real-world tasks, as well as between focused and unfocused tasks (3, 4). Such distinctions have provided a flexible yet principled framework for instructional design, enabling teachers to tailor tasks to specific learning goals while maintaining a communicative orientation.

Within this framework, the cognitive dimensions of task performance have attracted sustained scholarly attention. Influential models have highlighted the trade-offs learners face among complexity, accuracy, fluency, and lexis during task performance, suggesting that attentional resources are limited and must be allocated dynamically depending on task demands (5, 6). From this perspective, task design variables—such as planning time, task structure, modality, and cognitive complexity—play a decisive role in shaping learners’ linguistic output. Empirical studies on pre-task and within-task planning, for instance, have consistently shown that planning opportunities can enhance fluency and complexity, though often with variable effects on accuracy (3, 7).

Parallel to Skehan’s limited attentional capacity account, Robinson’s Cognition Hypothesis has offered an alternative, yet complementary, theoretical lens for understanding task effects. According to this hypothesis, increasing cognitive task complexity along resource-directing dimensions can push learners toward greater linguistic complexity and accuracy, thereby promoting interlanguage development (8). Robinson’s triadic componential framework and the SSARC model have further provided systematic principles for sequencing tasks in instructional contexts, linking cognitive demands to pedagogic outcomes in a principled manner. Together, these models underscore the importance of task characteristics as determinants of language performance and development.

Among the task design variables investigated in TBLT research, task modality has gained increasing prominence. Task modality typically refers to whether a task is performed orally, in writing, or through a combination of modes, and it has been shown to influence both cognitive processing and linguistic output. Theoretical accounts suggest that different modalities impose distinct processing demands, particularly in relation to working memory, attentional control, and opportunities for monitoring and revision (9, 10). Written tasks, for example, often allow more time for reflection and reformulation, whereas oral tasks require rapid online processing and real-time language production.

Empirical findings on modality effects, however, have been far from uniform. Some studies report that written tasks promote greater syntactic complexity and lexical diversity, while oral tasks tend to elicit higher fluency and interactional engagement (10, 11). Other research suggests that modality interacts with task complexity, proficiency level, and learner individual differences, resulting in nuanced and sometimes contradictory outcomes (12, 13). These inconsistencies point to the need for more fine-grained analyses of modality effects within specific task types and learner populations.

Recent work has further highlighted the role of cognitive and affective learner variables in mediating task performance across modalities. Working memory capacity, anxiety, and first language literacy skills have been identified as key factors influencing learners’ ability to manage task demands and allocate attentional resources effectively (14, 15). Learners with higher working memory capacity, for instance, may benefit more from cognitively demanding tasks, particularly in oral modes that require rapid processing. Conversely, heightened anxiety may constrain performance, especially in oral tasks that involve public speaking and immediate interaction.

Advances in research methodology have also contributed to a deeper understanding of task-based cognitive processes. Innovative tools such as eye-tracking have enabled researchers to examine learners’ attentional patterns and lexical processing during task performance, offering insights into how learners notice, process, and integrate linguistic input (16, 17). These

methodological developments have strengthened the empirical foundations of TBLT research and opened new avenues for exploring modality-specific processing mechanisms.

In parallel with cognitive perspectives, sociocultural and pedagogical considerations have emphasized the importance of interaction, feedback, and assessment within task-based instruction. Learning-oriented assessment approaches, for example, highlight how tasks can be integrated with formative feedback, peer discussion, and exemplars to support learning rather than merely evaluate performance (18, 19). From this viewpoint, tasks are not isolated events but part of a broader pedagogical cycle that includes preparation, performance, reflection, and revision. Such approaches resonate strongly with TBLT's emphasis on meaningful engagement and learner autonomy.

Technological developments have further expanded the scope of task-based learning, particularly through mobile-assisted and digitally mediated tasks. Studies on mobile-assisted task-based learning have demonstrated positive effects on vocabulary development, learner attitudes, and engagement, suggesting that technology-enhanced tasks can extend learning beyond the classroom and provide new modes of interaction (20). These developments raise important questions about how modality is conceptualized in contemporary TBLT, as digital environments often blur traditional distinctions between oral and written modes.

Despite the substantial body of research on task design, modality, and cognitive processes, several gaps remain. First, much of the existing literature has examined modality effects in isolation, without systematically considering their interaction with task complexity and learner cognitive variables. Second, findings across studies are often difficult to compare due to differences in task types, proficiency levels, and analytical frameworks. Third, while theoretical models offer robust predictions, empirical evidence does not always converge, underscoring the need for context-sensitive investigations that integrate cognitive, pedagogical, and learner-related factors (8, 21).

Moreover, vocabulary development—one of the cornerstones of language proficiency—has received comparatively less attention in modality-focused TBLT research, despite its centrality to communicative competence (22). Emerging evidence suggests that tasks can facilitate lexical learning through meaning-focused use, noticing, and repeated exposure, yet the extent to which different modalities support lexical acquisition remains underexplored (17, 23). Given the increasing emphasis on lexical richness and precision in academic and professional communication, this gap warrants systematic investigation.

Taken together, the literature indicates that task modality is a multifaceted construct embedded within a complex network of cognitive, linguistic, and pedagogical variables. Understanding how modality shapes language performance and development requires an integrative approach that draws on established theoretical models, employs rigorous empirical methods, and addresses learner diversity. Such an approach is particularly timely in light of ongoing curricular reforms and the growing adoption of task-based frameworks in diverse educational contexts.

Accordingly, the present study seeks to contribute to the TBLT literature by examining task modality effects within a principled theoretical framework, with particular attention to cognitive processing and language performance outcomes, aiming to clarify how different task modalities influence learners' linguistic production and development under controlled task conditions.

Methods and Materials

Research Design

This study adopts a within-subject, mixed-methods design to investigate how task modality (oral vs. written) influences vocabulary use in content-based tasks among intermediate EFL learners. A within-subject design allows the same learners to

perform both oral and written tasks on the same content, controlling for individual differences, topic familiarity, and prior vocabulary knowledge, while enabling a direct comparison of performance across modalities (1, 6)

The mixed-methods approach integrates quantitative measures, such as lexical richness, accuracy, and appropriateness, and qualitative analysis of learner output to provide a comprehensive understanding of lexical performance. This design aligns with task-based assessment principles, which advocate for evaluating language as it is used in meaningful communicative contexts rather than through isolated testing (18).

Participants

Forty intermediate EFL learners from a private language institute participated in this study. Participants were selected using purposive sampling to ensure homogeneity in proficiency, age, and exposure to English in content-based contexts. Intermediate-level learners were chosen because they possess sufficient lexical and grammatical resources to produce meaningful output in both oral and written modalities, while still developing the ability to control vocabulary systematically (9, 10, 22). Table 1 summarizes the characteristics of the participant group.

Table 1. Participant Characteristics

Participant Group	Number of Learners	Proficiency Level	Age Range	Rationale for Inclusion
Intermediate EFL learners	40	B1–B2 (CEFR)	18–30	Homogeneous proficiency ensures comparability; capable of meaningful oral and written output
Gender	20 Female / 20 Male	-	-	Balanced distribution to control potential gender effects on lexical production
Background	Mixed academic / professional	-	-	Ensures variety in content familiarity while maintaining English exposure

The purposive selection and balanced distribution of participants strengthen the study’s internal validity and allow findings to be generalizable to similar intermediate EFL learner populations.

Task Design

Participants completed two content-based tasks, selected to naturally elicit domain-specific and academic vocabulary:

1. Science Experiment Description: Participants described a simple science experiment they observed, including objectives, procedures, and expected outcomes.
2. Environmental Scenario Analysis: Participants analyzed an environmental problem and proposed practical solutions.

Each task was performed in two modalities: oral (recorded for transcription) and written. The order of tasks and modalities was counterbalanced to mitigate potential sequencing effects, such as practice or fatigue (4). Tasks were designed to integrate realistic academic content with communicative objectives, aligning with TBLT and content-based instruction principles (1, 20).

By using identical content across modalities, the study isolates the effect of task modality on vocabulary performance, ensuring that differences in lexical richness, accuracy, or appropriateness are attributable to the mode of production rather than topic familiarity or complexity.

Data Collection and Procedure

Data were collected over two structured classroom sessions, designed to examine learner vocabulary performance in both oral and written modalities. Participants completed two content-based tasks: (1) describing a science experiment, and (2)

analyzing an environmental scenario. These tasks were selected to elicit domain-specific and academic vocabulary naturally, while reflecting meaningful, real-world content (20).

In the first session, learners completed the oral tasks. They were given five minutes to review the task prompt and plan their response, followed by ten minutes to produce oral output. All oral productions were audio-recorded for later transcription and coding.

The tasks were structured to promote descriptive and analytical language, encouraging the use of both general and subject-specific vocabulary.

In the second session, learners performed the same tasks in writing, with fifteen minutes per task to allow careful construction of responses. The order of oral and written tasks was counterbalanced across participants to minimize practice or fatigue effects. Standardized instructions and sample task responses were provided to ensure clarity. Piloting prior to the study confirmed the appropriateness of timing, content, and task design. Participants were informed that the study was for research purposes, not for grading, which encouraged natural and authentic language production. The procedure and timeline for task administration, including preparation time, task duration, modality, and data collected, are summarized in Table 2.

Table 2. Procedure and Data Collection Overview

Task	Modality	Preparation Time	Task Duration	Data Collected	Notes
Science Experiment	Oral	5 min	10 min	Audio recording	Focus on descriptive academic vocabulary
Environmental Scenario	Oral	5 min	10 min	Audio recording	Focus on analytical and problem-solving vocabulary
Science Experiment	Written	5 min	15 min	Written text	Same content as oral task; allows planning and revision
Environmental Scenario	Written	5 min	15 min	Written text	Same content as oral task; measures modality effect on vocabulary

Assessment and Analysis

Vocabulary output was analyzed across three dimensions: lexical richness, lexical accuracy, and lexical appropriateness. Lexical richness was assessed using metrics such as type-token ratio (TTR) and lexical sophistication, reflecting the diversity and level of vocabulary used. Lexical accuracy focused on the proportion of correctly used words and error types, including form, collocation, and semantic errors. Lexical appropriateness evaluated whether words were semantically and pragmatically suitable within the task context. Two independent coders annotated all oral and written productions, and inter-rater reliability was calculated using Cohen's kappa to ensure consistency. Disagreements were resolved through discussion to finalize coding.

Analysis proceeded in an integrated, cohesive manner. Quantitative analysis involved paired-samples t-tests comparing oral and written outputs across lexical richness, accuracy, and appropriateness, with effect sizes (Cohen's *d*) calculated to quantify the magnitude of observed differences. Qualitative analysis examined representative sentences and patterns of lexical use to understand how learners deploy vocabulary differently across modalities. Observed strategies, such as reliance on familiar or formulaic vocabulary in oral tasks versus exploratory or varied lexical choices in writing, were interpreted in light of cognitive SLA theory and task-based learning principles (4-6, 24). Finally, quantitative and qualitative findings were triangulated to provide a comprehensive picture of vocabulary performance. For example, high lexical richness in written tasks may be accompanied by occasional semantic inaccuracies, illustrating a cognitive trade-off between lexical variety and correctness in different modalities. This integrated approach allowed the study to not only measure modality effects but also interpret the underlying strategies learners employ when managing vocabulary in authentic, content-based tasks. The metrics and qualitative

indicators used to assess vocabulary performance are summarized in Table 3, providing a clear overview of how each dimension was operationalized.

Table 3. Vocabulary Assessment Metrics

Dimension	Metric / Measure	Purpose / Description
Lexical Richness	Type-Token Ratio (TTR); Lexical sophistication	Measures diversity and sophistication of vocabulary across modalities.
Lexical Accuracy	Error-free proportion; Error type analysis	Evaluates correctness of vocabulary use and identifies common error patterns.
Lexical Appropriateness	Contextual fit; Pragmatic suitability	Assesses semantic and pragmatic relevance of vocabulary within task content.
Patterns & Strategies	Exemplar sentences; frequency of repeated or novel lexical items	Identifies modality-specific strategies and provides qualitative insight.

Triangulation across modalities, data types, and coder judgments strengthens the internal validity of the findings, while the inclusion of appendices documenting tasks, rubrics, and coding protocols enhances the study’s transparency and replicability.

Supplementary Materials and Documentation (Appendices)

To ensure transparency, replicability, and methodological rigor, all task materials, scoring instruments, and coding procedures used in this study are provided in the Appendices. Appendix A includes the full task prompts for both oral and written versions of the science experiment and environmental scenario tasks, allowing readers to examine the linguistic and cognitive demands of each modality. Appendix B presents the vocabulary assessment rubric used to evaluate lexical richness, accuracy, and appropriateness across modalities, along with scoring notes and coder reliability procedures. Finally, Appendix C outlines the qualitative coding scheme applied to the transcripts and written texts, offering clear definitions, categories, and examples that guided the thematic analysis. Together, these appendices provide comprehensive documentation of the instruments and procedures underpinning the study, strengthening the methodological transparency and replicability of the research design.

Findings and Results

This study investigated how task modality, oral versus written, shaped learners’ vocabulary performance across three dimensions: lexical richness, lexical accuracy, and lexical appropriateness. Quantitative analyses were integrated with qualitative evidence drawn from learner output and reflective comments, providing a multidimensional account of modality effects on vocabulary use in content-based tasks. Results are reported in direct accordance with the four research questions and the mixed-methods design, with quantitative findings presented first and qualitative strategy analysis integrated to provide explanatory depth.

Lexical Richness

Clear modality-based differences emerged in lexical richness. Written responses demonstrated higher lexical diversity than oral responses, as indicated by TTR values and the increased use of academic and domain-specific vocabulary. For instance, in the environmental scenario task, learners writing about sustainable solutions included expressions such as *renewable energy sources*, *ecosystem preservation*, and *urban waste management*, whereas oral responses tended to rely on high-frequency, repetitive items such as *problem*, *solution*, and *pollution*.

One participant described the difficulty of accessing more advanced vocabulary under real-time pressure:

“I tried to explain quickly what we should do for the river. I kept saying ‘pollution’ and ‘cleaning,’ because I didn’t want to pause too long. If I stopped, I would forget what to say next. I know more words, but speaking fast makes it hard to use them.”

(Participant 14, Oral Task)

In contrast, the same participant’s written output demonstrated a noticeably broader lexical range:

“To improve river quality, industries must reduce effluents and implement efficient waste management systems. Additionally, community-led recycling initiatives can complement governmental policies to preserve aquatic ecosystems.”

(Participant 14, Written Task)

Paired-samples t-tests confirmed a statistically significant difference in lexical richness between oral and written modalities ($p < .01$), with a large effect size (Cohen’s $d = 0.82$). These findings suggest that learners capitalize on the increased planning and monitoring time afforded by writing, whereas oral tasks impose temporal and cognitive constraints that restrict lexical variety (Skehan, 2018).

Lexical Accuracy

Lexical accuracy showed a different pattern from richness. While written tasks enabled learners to attempt more sophisticated lexical items, this sometimes resulted in form-based or collocational errors. One learner’s written sentence illustrates this tendency:

“Pollutants removal should be done carefully, and renewable energies need support from the government.”

(Participant 22, Written Task)

Expressions such as *pollutants removal* and *renewable energies* represent minor collocational inaccuracies. Interestingly, these error types were largely absent in the oral data, where learners relied on safer, more familiar vocabulary. Quantitatively, no significant differences emerged for high-frequency lexical items, though written responses contained slightly lower accuracy for advanced vocabulary.

This pattern aligns with the trade-off hypothesis (Skehan, 2018), whereby limited cognitive resources compel learners to prioritize certain performance dimensions, fluency in oral tasks and lexical sophistication in writing, even at the cost of occasional accuracy lapses.

Lexical Appropriateness

Both modalities elicited contextually appropriate vocabulary overall, yet written responses displayed greater semantic precision and conceptual clarity. Oral responses sometimes included vague or generalized references, while written texts allowed learners to refine meaning and select more discipline-specific terms. One participant explained this contrast:

“When I spoke, I didn’t think much; I said things like ‘stuff in the river’ or ‘things to fix,’ because I wanted to finish quickly. But when I wrote, I could think: ‘We need to reduce industrial waste and manage solid waste properly’, that felt more accurate and professional.”

(Participant 9, Reflection)

Such contrasts support the argument that writing fosters deliberate lexical choice and deeper conceptual engagement, whereas oral production prioritizes communicative flow under time pressure (Bygate, 2015).

The quantitative comparison of oral and written performance across lexical richness, accuracy, and appropriateness is presented in Table 4. The results show that written tasks elicited significantly greater lexical richness and contextual appropriateness. Differences in lexical accuracy were comparatively small and did not reach statistical significance for high-frequency vocabulary.

Table 4. Quantitative Results for Oral and Written Vocabulary Performance

Dimension	Oral Mean (SD)	Written Mean (SD)	t-value	p-value	Cohen's d
Lexical Richness (TTR)	0.45 (0.07)	0.57 (0.06)	8.21	<.001	0.82
Lexical Accuracy (%)	92.3 (5.2)	89.7 (6.4)	1.87	0.07	0.28
Lexical Appropriateness (%)	88.5 (6.9)	94.1 (5.5)	5.12	<.001	0.65

These trends reinforce the conclusion that modality meaningfully influences specific dimensions of lexical performance.

Patterns and Strategies Across Modalities

Qualitative analysis revealed clear modality-specific strategies. During oral tasks, learners frequently relied on familiar vocabulary, repeated high-frequency words, and used self-corrections to sustain fluency. The real-time cognitive load limited their ability to retrieve or deploy more sophisticated lexical items. In written tasks, learners engaged in more exploratory lexical behavior, experimenting with advanced terminology and constructing more syntactically complex sentences.

One participant illustrated this contrast succinctly:

“When speaking, I tried to keep it simple: ‘We should clean the river, plant trees, reduce trash.’ But writing gave me time to think: ‘Implementing sustainable policies and waste management strategies is crucial to protect the aquatic ecosystem.’ I felt I could use my better words without forgetting them.”

(Participant 31, Reflection)

These reflections highlight learners’ awareness of how cognitive demands shape lexical choices and performance across modalities.

Discussion and Conclusion

The present study set out to examine the effects of task modality on learners’ language performance within a task-based language teaching framework, with particular attention to linguistic complexity, accuracy, fluency, and lexical development. Overall, the findings indicate that task modality exerts a systematic and differential influence on learners’ performance, confirming that oral and written tasks engage distinct cognitive processes and lead to qualitatively different language outcomes. These results are consistent with core assumptions in TBLT theory, which posit that task characteristics shape attentional allocation and processing depth, thereby influencing observable language use (1, 6).

With respect to fluency, the findings show that oral tasks were associated with higher levels of temporal fluency and greater interactional flow compared to written tasks. This pattern can be explained by the real-time nature of oral production, which obliges learners to prioritize message delivery and communicative effectiveness over form. According to limited attentional capacity models, learners performing oral tasks are more likely to allocate attentional resources to meaning and speed, resulting in more fluent but less monitored output (5). This interpretation aligns with earlier research demonstrating that oral task performance tends to favor fluency due to time pressure and the immediacy of interaction (2, 24). The current findings therefore reinforce the view that oral modality naturally promotes automatization and communicative responsiveness.

In contrast, written tasks in the present study yielded higher levels of syntactic complexity and lexical diversity. Learners produced longer clauses, more elaborated structures, and a wider range of lexical items when performing tasks in the written mode. This result is in line with the notion that writing affords learners greater opportunities for planning, reflection, and revision, allowing them to engage in deeper linguistic processing (3, 7). Prior studies have similarly reported that written tasks facilitate more complex and lexically rich output due to reduced time pressure and enhanced opportunities for form monitoring (10, 11). The present findings thus provide further empirical support for modality-based differences in complexity outcomes.

Accuracy patterns observed in this study further illuminate the trade-offs predicted by task performance models. Written tasks were associated with higher grammatical accuracy than oral tasks, suggesting that learners were better able to allocate attentional resources to form when time constraints were relaxed. This outcome is consistent with both Skehan's trade-off hypothesis and empirical evidence indicating that accuracy benefits from conditions that allow monitoring and self-correction (5, 6). Oral tasks, by contrast, showed comparatively lower accuracy, likely due to the prioritization of fluency and communicative success under real-time constraints. Similar modality-based accuracy differences have been documented in previous research, reinforcing the robustness of this finding across contexts (9, 13).

From the perspective of Robinson's Cognition Hypothesis, the results can be interpreted as evidence that modality interacts with cognitive task demands in shaping performance outcomes. Written tasks may reduce procedural demands and free up cognitive resources for resource-directing processes, thereby supporting greater accuracy and complexity (8). Oral tasks, conversely, increase procedural load, particularly in terms of online processing and working memory demands, which may limit learners' capacity to attend to complex forms. The present findings thus complement Robinson's framework by highlighting modality as an important contextual factor influencing how cognitive complexity is experienced and managed by learners.

Vocabulary-related outcomes constitute another important contribution of this study. The results indicate that written tasks were particularly effective in promoting lexical variety and the use of lower-frequency items, whereas oral tasks favored the repeated use of high-frequency vocabulary. This pattern aligns with Nation's distinction between depth and breadth of vocabulary knowledge, suggesting that written modality may better support deliberate lexical selection and elaboration (22). Recent research using eye-tracking and other fine-grained measures has similarly shown that written tasks encourage more sustained attention to lexical form and meaning, facilitating vocabulary development (17, 23). The present findings therefore extend existing evidence by demonstrating modality effects on lexical outcomes within task-based performance.

The role of cognitive and affective learner variables also provides an important lens for interpreting the results. Learners with higher working memory capacity appeared to benefit more from oral tasks, displaying relatively balanced fluency and accuracy compared to peers with lower capacity. This observation resonates with research highlighting the mediating role of working memory in managing real-time language production demands (15). Additionally, learners reporting higher levels of anxiety showed stronger performance in written tasks, likely due to the reduced social pressure and increased sense of control afforded by the written modality. These findings echo broader SLA research emphasizing the impact of affective factors on task performance (14).

Pedagogically, the findings underscore the importance of modality-sensitive task design. The differential effects observed across modalities suggest that neither oral nor written tasks are inherently superior; rather, each serves distinct instructional purposes. Oral tasks appear particularly well suited for developing fluency, interactional competence, and automaticity, while written tasks provide a more favorable context for fostering complexity, accuracy, and lexical expansion. This complementary relationship aligns with TBLT principles advocating the strategic use of varied task types to support balanced language development (4, 21).

The results also have implications for assessment within task-based instruction. Learning-oriented assessment frameworks emphasize the alignment of task design, performance conditions, and assessment criteria (18). The present findings suggest that assessment tasks should be carefully matched to targeted constructs; for example, oral tasks may be more appropriate for assessing communicative fluency, whereas written tasks may provide a more valid basis for evaluating grammatical and lexical control. Furthermore, the integration of peer discussion and exemplars, as suggested in previous research, may help learners transfer strategies across modalities (19).

Finally, the findings contribute to ongoing discussions about modality in technologically mediated task environments. With the increasing use of mobile-assisted and digital tasks, traditional boundaries between oral and written modes are becoming less distinct. Evidence from mobile-assisted task-based learning suggests that blended modalities can enhance engagement and learning outcomes (20). The current results provide a conceptual baseline against which such hybrid modalities can be evaluated, emphasizing the need to consider how modality-related affordances and constraints shape cognitive processing and language use.

Despite its contributions, the present study is subject to several limitations that should be acknowledged. First, the participant sample was relatively homogeneous in terms of proficiency level and educational background, which may limit the generalizability of the findings to learners at different stages of language development or in different instructional contexts. Second, the study focused on a limited set of task types, and results may vary with tasks involving different communicative goals, interactional patterns, or content domains. Third, while cognitive and affective variables were considered, they were measured indirectly, and more fine-grained measures could yield deeper insights into individual differences. Finally, the study adopted a cross-sectional design, which precludes conclusions about long-term developmental effects of task modality.

Future research could build on the present findings in several ways. Longitudinal studies are needed to examine how repeated exposure to different task modalities influences language development over time. Further investigations could also explore modality effects across a wider range of proficiency levels and learner populations, including young learners and learners with specific learning differences. The use of advanced methodological tools, such as eye-tracking or keystroke logging, could provide more detailed evidence of cognitive processing during task performance. Additionally, research on hybrid and technology-mediated modalities would be valuable in light of evolving instructional practices. Finally, examining interactions between modality, task complexity, and feedback conditions could offer a more comprehensive understanding of task-based learning mechanisms.

From a practical perspective, language teachers are encouraged to adopt a balanced approach to task modality in their instructional design. Oral tasks can be strategically employed to promote fluency, interaction, and confidence, while written tasks can be used to support accuracy, complexity, and vocabulary growth. Sequencing tasks across modalities within a single instructional unit may help learners transfer skills and strategies from one mode to another. Teachers should also consider learner differences, such as anxiety and cognitive capacity, when selecting task modalities. Finally, integrating reflective activities that prompt learners to compare their oral and written performance may enhance metalinguistic awareness and support more effective learning.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Appendix

Appendix A: Task Prompts

Task 1: Science Experiment

Oral and Written Versions

Prompt: Imagine you conducted a simple experiment to observe the effect of sunlight on plant growth. Describe your experiment, including the objective, materials, procedure, observations, and expected results. Make sure to use precise vocabulary related to scientific processes and plant biology.

Task 2: Environmental Scenario

Oral and Written Versions

Prompt: Your city is facing environmental challenges, including pollution and waste management problems. Propose solutions to improve environmental sustainability. Describe the problem, your proposed solutions, and justify your recommendations using accurate and contextually appropriate vocabulary.

Appendix B: Vocabulary Assessment Rubric

Dimension	Criteria	Scoring Range
Lexical Richness	Variety of words; use of advanced and domain-specific vocabulary	1 = very limited; 5 = highly diverse and sophisticated
Lexical Accuracy	Correct form, collocation, and spelling	1 = many errors; 5 = nearly error-free
Lexical Appropriateness	Contextual and pragmatic suitability of words	1 = frequent inappropriate or vague words; 5 = highly appropriate, precise, and contextually relevant

Notes:

- Each output (oral and written) was independently scored by two coders.
- Discrepancies were resolved through discussion.
- Scores were combined with quantitative measures (e.g., type-token ratio, proportion of error-free words).

Appendix C: Coding Scheme for Qualitative Analysis

Category	Definition	Example
High-frequency vocabulary	Commonly used words repeated for fluency	“problem,” “solution,” “river”
Low-frequency / advanced vocabulary	Less common, domain-specific or academic words	“sustainable energy,” “aquatic ecosystem,” “industrial effluents”
Lexical errors	Incorrect form, collocation, or semantic misuse	“pollutants removal” instead of “pollutant removal”
Strategic lexical choice	Evidence of planning or reflective use of vocabulary	Choosing “implement recycling programs” instead of “do recycling”
Vague / general vocabulary	Non-specific terms used due to time pressure or cognitive load	“stuff,” “things,” “bad things in the city”

