

Research Article

Didactic Interlingual Subtitling as an Extracurricular Approach to ESP Vocabulary Development: Evidence from Iranian Engineering Students

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ABSTRACT

This study investigated the effectiveness of didactic interlingual subtitling as an extracurricular approach to enhancing English for Specific Purposes (ESP) vocabulary learning among Iranian engineering students. Using a mixed-methods repeated-measures design, 33 undergraduate engineering students at Shahid Chamran University of Ahvaz participated in a nine-week instructional program involving three cycles of extracurricular vocabulary learning activities: conventional vocabulary exercises, standard didactic subtitling (English-to-Persian), and reverse didactic subtitling (Persian-to-English). Data were collected through a Vocabulary Level Test, formative and summative vocabulary achievement tests, and a post-treatment perception questionnaire. The findings revealed significant differences among the three instructional conditions in both vocabulary learning and long-term retention. Standard didactic subtitling produced the highest learning gains, followed by reverse subtitling, whereas conventional vocabulary exercises yielded the lowest performance. Learners also expressed significantly more positive attitudes toward subtitling-based activities, particularly standard subtitling, which was perceived as more engaging and motivating. Positive correlations were also found between learners' attitudes toward subtitling activities and their vocabulary learning outcomes. Practical implications for ESP instruction, curriculum design, and technology-mediated vocabulary learning are discussed.

Introduction

Vocabulary knowledge is widely recognized as a cornerstone of second and foreign language proficiency, serving as a primary resource for comprehension, communication, and academic performance (Carcamo, 2023; Nation, 2022; Teng, 2025; Teng, 2026). In English as a Foreign Language (EFL) contexts, vocabulary acquisition is particularly critical, as it directly influences learners' ability to interpret meaning and engage in meaningful interaction across disciplines (Nassaji, 2004, Schmitt, 2008, 2014). This importance becomes even more pronounced in English for Specific Purposes (ESP), where learners are required to master discipline-specific terminology that enables participation in academic and professional discourse (Al Zahrani & Chaudhary, 2022). For engineering students, in particular, mastery of ESP vocabulary is essential for accessing technical knowledge, engaging with international scientific communities, and ensuring future professional competence. Despite its centrality, ESP vocabulary acquisition remains a persistent challenge due to the abstract, technical, and low-frequency nature of specialized lexical items, as well as limited exposure to authentic language input in EFL settings (Danilina & Shabunina, 2020).

Traditional vocabulary instruction, often characterized by decontextualized drills, rote memorization, and form-focused exercises, has been criticized for its limited capacity to support durable lexical retention and meaningful use (Hayati et al., 2013; Mashhadi et al., 2016; Rasti-Behbahani & Mashhadi, 2026). Such approaches frequently fail to engage learners cognitively and affectively, leading to reduced motivation, shallow processing, and limited long-term retention. These challenges are particularly evident

among Iranian engineering students, who must acquire large volumes of technical vocabulary while simultaneously coping with limited opportunities for authentic language use outside the classroom and increased cognitive demands associated with their disciplinary studies (Afzal, 2019). Consequently, there is a growing pedagogical need for instructional approaches that are both cognitively effective and motivationally engaging.

In response to these challenges, recent scholarship has increasingly turned to technology-enhanced and multimodal approaches to language instruction, particularly Audiovisual Translation (AVT) (Ávila-Cabrera, 2021; Bobadilla-Pérez & de Santiago, 2022; Talaván et al., 2017). Within this paradigm, didactic subtitling has emerged as a promising pedagogical tool that integrates linguistic, visual, and contextual input within a unified learning experience (Lertola & Zanón, 2022; Talaván & Lertola, 2022; Talaván & Rodríguez-Arancón, 2014; Talaván et al., 2023). Subtitling, in its interlingual form, includes standard subtitling (L2-L1) and reverse subtitling (L1-L2), both of which involve translation processes that can facilitate vocabulary learning through contextualized meaning-making (Caimi, 2006). Unlike traditional receptive use of subtitles, contemporary didactic subtitling emphasizes learner production, requiring students to actively create subtitles rather than passively consume them. This shift transforms learners from passive recipients of input into active mediators of meaning, thereby increasing cognitive engagement and depth of processing (McLoughlin et al., 2020; Talaván, 2010).

Accordingly, the following research questions guide the study:

1. To what extent do standard subtitling and reverse subtitling differ in enhancing ESP vocabulary acquisition among Iranian engineering students compared with conventional extracurricular vocabulary-learning activities?
2. To what extent do standard subtitling and reverse subtitling differ in facilitating the long-term retention of ESP vocabulary among Iranian engineering students compared with conventional extracurricular vocabulary-learning activities?
3. How do Iranian engineering students perceive standard subtitling and reverse subtitling as extracurricular translation-based activities for ESP vocabulary learning?
4. Is there a significant relationship between Iranian engineering students' perceptions of subtitling-based extracurricular activities and their ESP vocabulary learning and retention outcomes?

These research questions seek to advance contemporary discussions on the integration of audiovisual translation into language education by demonstrating how didactic interlingual subtitling can serve as a meaningful bridge between language learning, translation practice, and professional communication. Through its focus on ESP vocabulary development among Iranian engineering students, the research aims to provide empirical evidence supporting the pedagogical potential of subtitling-based activities in fostering more effective, autonomous, and engaging vocabulary learning experiences in EFL contexts.

Literature Review

Theoretical Foundations

The pedagogical value of didactic subtitling can be theoretically explained through several complementary cognitive frameworks. The

Dual Coding Theory (Paivio, 1986) posits that information is processed through both verbal and non-verbal systems, and that learning is enhanced when both channels are activated simultaneously. Didactic subtitling aligns with this principle by requiring learners to integrate spoken language, visual context, and written translation, thereby creating multiple representational pathways that strengthen memory and recall. The Cognitive Load Theory (Sweller, 1988) further explains how subtitling may optimize learning by balancing intrinsic, germane, and extraneous cognitive load. While subtitle production increases intrinsic and germane load through meaningful processing of complex input, it can reduce extraneous load by allowing learners to structure and interpret information according to their own cognitive strategies. Similarly, the Cognitive Theory of Multimedia Learning (Mayer, 2005) emphasizes that learning is most effective when learners actively integrate information across dual channels—visual and verbal—under conditions of temporal and spatial contiguity. Didactic subtitling operationalizes these principles by synchronizing audiovisual input with learner-generated textual output, thereby facilitating deeper cognitive integration and vocabulary acquisition.

Empirical Studies on Didactic Subtitling

Empirical research has consistently supported the effectiveness of subtitling in language learning. Studies on subtitled input demonstrate that both intralingual (L2-L2) and interlingual (L2-L1) subtitles can enhance vocabulary acquisition, listening comprehension, and overall language development by providing multimodal input and contextualized lexical exposure (Frumuselu et al., 2015; Haider & Al-Salman, 2022; Lertola, 2021). Intralingual subtitles

have been shown to strengthen form-meaning mapping and lexical recognition, while interlingual subtitles offer immediate semantic support, particularly for lower-proficiency learners (Bostanci, 2022; Wu & Yang, 2022; Zarei & Rashvand, 2011). Reverse subtitling (L1-L2), although less extensively studied, has demonstrated potential in enhancing word recognition and productive vocabulary knowledge by reinforcing bidirectional lexical associations between L1 and L2 (Ávila-Cabrera & Rodríguez-Arancón, 2021; Kord et al., 2022; Van der Kolk & Feijoo, 2024). These findings suggest that subtitling as a supportive input tool contributes significantly to vocabulary development, especially when embedded in meaningful audiovisual contexts.

More recent research has shifted toward the use of subtitling as an active learning task, commonly referred to as didactic subtitling. In this approach, learners are required to produce subtitles, thereby engaging in translation, reformulation, and meaning negotiation processes. This active engagement has been associated with improvements in multiple language skills, including vocabulary acquisition, listening comprehension, writing development, and translation competence (Lertola, 2021; Talaván et al., 2017). Empirical studies have shown that didactic subtitling fosters deeper cognitive processing and incidental vocabulary learning compared to non-subtitling conditions (Lertola, 2012). Collaborative and task-based subtitling activities further enhance lexical retention by promoting negotiation of meaning, peer interaction, and contextualized language use (McLoughlin & Lertola, 2014). In particular, interlingual subtitling tasks have been shown to improve learners' ability to map lexical items across languages, thereby strengthening vocabulary retention and productive use.

Within ESP contexts, the pedagogical relevance of didactic subtitling is especially pronounced (Ávila-Cabrera & Rodríguez-Arancón, 2021; Ávila-Cabrera, 2021). ESP learners are required to acquire specialized vocabulary that is often highly technical and difficult to learn through conventional instructional approaches. Translation-based pedagogies, including subtitling, provide a meaningful bridge between linguistic form and disciplinary content by situating vocabulary within authentic, context-rich audiovisual materials (Chirobocea-Tudor, 2021). Empirical studies have demonstrated that standard subtitling can enhance vocabulary acquisition among students in fields such as history and psychology (Bellalem et al., 2018; Bianchi & Ciabattini, 2008), while task-based subtitling interventions outperform passive viewing conditions in promoting lexical gains (Fuentes-Luque & Campbell, 2020). Similarly, reverse subtitling has been effectively implemented in ESP courses for commerce, tourism, and translation studies, resulting in improved vocabulary acquisition and writing development (Ávila-Cabrera & Rodríguez-Arancón, 2021; Ávila-Cabrera, 2021; Cruz-García, 2024). These findings collectively suggest that interlingual subtitling can serve as a powerful pedagogical tool for ESP vocabulary instruction.

However, despite the growing body of literature, several important gaps remain. Comparative evidence regarding the relative effectiveness of standard and reverse subtitling in ESP contexts is still limited. Existing research has also largely concentrated on classroom-based implementations, leaving subtitling as an extracurricular learning activity insufficiently explored, particularly in relation to learner autonomy and extended language exposure. In addition, long-term vocabulary

retention has received relatively little systematic attention, despite its central role in sustainable language development. Learners' perceptions of subtitling-based instruction and their relationship with vocabulary learning outcomes also remain underexamined, especially in EFL contexts involving engineering students.

Addressing these gaps, the present study investigates the efficacy of didactic interlingual subtitling as an extracurricular translation-based activity for enhancing ESP vocabulary learning among Iranian engineering students. Specifically, it compares the effectiveness of standard and reverse subtitling with conventional vocabulary learning methods in promoting both immediate vocabulary acquisition and long-term retention. In addition, it explores learners' perceptions of subtitling-based activities and examines the relationship between these perceptions and vocabulary learning outcomes. By integrating cognitive, multimedia, and translation-based theoretical perspectives with empirical evidence from AVT and ESP research, this study seeks to contribute to a more comprehensive understanding of how didactic interlingual subtitling can enhance specialized vocabulary learning in technologically mediated EFL environments.

Methodology

Research Design

This study employed a mixed-methods design to investigate the effectiveness of didactic interlingual subtitling in enhancing ESP vocabulary acquisition and retention among Iranian undergraduate engineering students. The design compared three instructional conditions—conventional vocabulary practice, standard keyword subtitling, and reverse keyword subtitling—

implemented within a structured, technology-mediated extracurricular learning environment over a nine-week period.

The quantitative strand involved multiple stages of measurement, including a Vocabulary Level Test, repeated formative achievement assessments following each instructional phase, and a delayed summative test administered four weeks after the intervention. The qualitative dimension was operationalized through a post-treatment perception questionnaire designed to capture learners' motivational orientations, perceived usefulness of subtitling-based instruction, and their willingness to adopt such techniques in future learning contexts. The integration of these two data strands enabled a comprehensive evaluation of both measurable learning outcomes and subjective learner experiences, thereby strengthening the ecological validity and interpretive depth of the findings.

Participants and Instructional Context

Participants were recruited from undergraduate engineering programs at Shahid Chamran University of Ahvaz through an open call for voluntary participation in an ESP vocabulary development program. From an initial pool of 129 interested students, 61 remained after orientation via a Telegram-based briefing outlining study requirements and expectations. Following administration of a demographic and background questionnaire, a final sample of 33 participants was selected based on prior experience with subtitle use or production, ensuring a baseline level of familiarity with multimodal learning environments. The final cohort included 20 males and 13 females, aged between 18 and 23 years, all of whom completed the full instructional intervention. These participants engaged in a structured nine-week

instructional module delivered through Telegram. The intervention was organized into three instructional cycles, each comprising three sequential phases aligned with the study conditions: conventional instruction, standard subtitling, and reverse subtitling.

Instructional Materials and Learning

Environment

The instructional content was developed around authentic engineering-related audiovisual materials selected from YouTube, covering domains such as energy systems, civil engineering, materials science, telecommunications, and industrial technologies. Transcripts of selected video clips were processed using OpenAI's ChatGPT-4 to generate structured instructional texts and vocabulary-focused exercises. A total of 115 engineering-related lexical items were initially extracted and subjected to a vocabulary familiarity screening task. Items unknown to at least 70% of participants were retained as target vocabulary, resulting in a final set of 42 target words. This selection procedure ensured an optimal level of lexical challenge, consistent with vocabulary acquisition research advocating exposure to partially unknown items to facilitate measurable learning gains.

To support instruction, teacher-developed worksheets and nine complementary video lessons were created. Each worksheet included three integrated components: phonetic transcription of target and challenging vocabulary, definitions with contextualized examples, and reading comprehension passages followed by structured tasks (multiple-choice, true/false, and short-answer questions). Instructional videos were distributed weekly via a dedicated Telegram channel, ensuring flexible access,

continuity of learning, and alignment between textual and audiovisual input.

Subtitling-Based Instructional Treatment

The core pedagogical intervention consisted of three systematically rotated instructional conditions implemented across nine treatment sessions. Each cycle included three distinct phases, ensuring that all participants experienced all conditions equally in a within-group design structure. In the conventional condition, learners engaged in vocabulary-focused exercises derived from instructional materials, including fill-in-the-blank tasks, matching activities, and multiple-choice questions. These tasks were designed to reinforce receptive and initial productive knowledge of engineering-specific lexical items. In the standard keyword subtitling condition, participants viewed one-minute English-language YouTube clips accompanied by English subtitles in which selected engineering terms were intentionally omitted. Learners were required to supply the missing items in Persian, thereby strengthening form-meaning mapping and lexical recognition under bilingual processing conditions. In the reverse keyword subtitling condition, Persian-dubbed videos with Persian subtitles were used. In this phase, English subtitles contained strategically omitted engineering terms. Participants were required to provide accurate English equivalents of the missing Persian lexical items, thereby engaging in more cognitively demanding productive retrieval and cross-linguistic transfer.

Across both subtitling conditions, target lexical items were deliberately omitted from subtitles to direct learners' attention to vocabulary form and meaning while minimizing extraneous cognitive load. After each session, participants submitted their completed tasks via Telegram in Microsoft

Word format. The instructor reviewed submissions and provided individualized corrective feedback to support ongoing vocabulary development. Strict privacy controls were implemented within the Telegram environment to prevent participant identification and minimize peer influence or answer sharing.

Instruments and Data Collection Procedures

Vocabulary knowledge was assessed using multiple instruments. A pre-treatment Vocabulary Level Test was first administered to determine baseline familiarity with engineering-related lexical items. Participants evaluated 115 candidate words and identified unfamiliar items. Words unknown to at least 70% of participants were selected as target vocabulary, resulting in 42 instructional items used throughout the study. To measure learning outcomes, researcher-made formative vocabulary tests were administered five days after each instructional phase to assess short-term acquisition. In addition, a delayed summative test was administered four weeks after completion of the intervention to evaluate long-term retention. The summative test included all 42 target words and was structured into three sections corresponding to the three instructional conditions.

All assessments were based on the Vocabulary Knowledge Scale (VKS) (Wesche & Paribakht, 1996), which captures vocabulary development along a continuum from recognition to productive use. The framework enabled evaluation of three dimensions of lexical knowledge development: registration, retention, and recall. Reliability of the

instruments was confirmed using Cronbach's alpha, ensuring internal consistency across test administrations. In addition to performance-based measures, a 20-item Likert-scale post-treatment questionnaire was administered to examine participants' perceptions of the instructional approaches. The questionnaire measured motivational engagement, perceived effectiveness, and willingness to adopt subtitling-based learning strategies in future learning contexts. Content validity was established through expert review by three specialists in TESOL and educational technology, while reliability was confirmed through Cronbach's alpha analysis.

Results

This section presents the findings related to the four research questions of the study. Descriptive statistics were first computed to examine the distributional properties of the data across the three instructional conditions: Conventional vocabulary practice, standard keyword subtitling, and reverse keyword subtitling. Subsequently, repeated-measures ANOVA and Pearson correlation analyses were conducted to examine differences in ESP vocabulary learning, long-term vocabulary retention, learner attitudes, and the relationship between attitudes and learning outcomes.

Table 1 presents the descriptive statistics for formative vocabulary learning, summative vocabulary retention, and learner attitudes across the three instructional conditions.

Table 1*Descriptive Statistics of Formative Vocabulary Learning, Summative Retention, and Attitudes*

Measure Category	Mean	Std. Deviation	Skewness	Kurtosis
Conventional Formative	2.2318	.46282	-.284	-.840
Standard Formative	3.9289	.65358	.063	-1.219
Reverse Formative	3.1148	.54265	.941	2.106
Conventional Summative	2.5797	.44692	-.009	-.386
Standard Summative	3.7345	.35878	.460	-.326
Reverse Summative	3.2124	.45974	-1.124	1.294
Conventional Attitude	1.9606	.47550	.007	-.289
Standard Attitude	3.8904	.71057	-.082	-.747
Reverse Attitude	3.4359	.72896	.577	.049

As shown in Table 1, ESP vocabulary learning among Iranian engineering students achieved the highest mean score in the standard subtitling condition, with the highest formative test mean score ($M = 3.9289$) corresponding to this activity. Furthermore, the reverse subtitling condition outperformed the conventional condition, as the mean score for reverse subtitling was 3.1148, compared to $M = 2.2318$ for the conventional condition. In terms of summative test performance, the standard subtitling activity again produced the highest mean score ($M = 3.7345$), followed by

reverse subtitling ($M = 3.2124$), and then conventional ($M = 2.5797$). Furthermore, all skewness and kurtosis values fell within the acceptable ranges suggested by Kline (2011), indicating normal distribution of the variables.

To answer the first research question, which examined whether significant differences existed among the three instructional conditions in terms of ESP vocabulary learning, a one-way repeated-measures ANOVA was conducted.

Table 2*Tests of Within-Subjects Effects for Formative Vocabulary Learning*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Type	Sphericity Assumed	47.547	2	23.773	73.378 .000
	Greenhouse-Geisser	47.547	1.992	23.872	73.378 .000
	Huynh-Feldt	47.547	2.000	23.773	73.378 .000
	Lower-bound	47.547	1.000	47.547	73.378 .000
Error (Type)	Sphericity Assumed	20.735	64	.324	
	Greenhouse-Geisser	20.735	63.737	.325	
	Huynh-Feldt	20.735	64.000	.324	
	Lower-bound	20.735	32.000	.648	

Computed using alpha = .05

The repeated-measures ANOVA revealed a statistically significant difference among the three instructional conditions in formative ESP vocabulary learning, $F(2, 64) = 73.378$, p

$< .001$. The Bonferroni post hoc test followed to determine between which activities the significant differences exist.

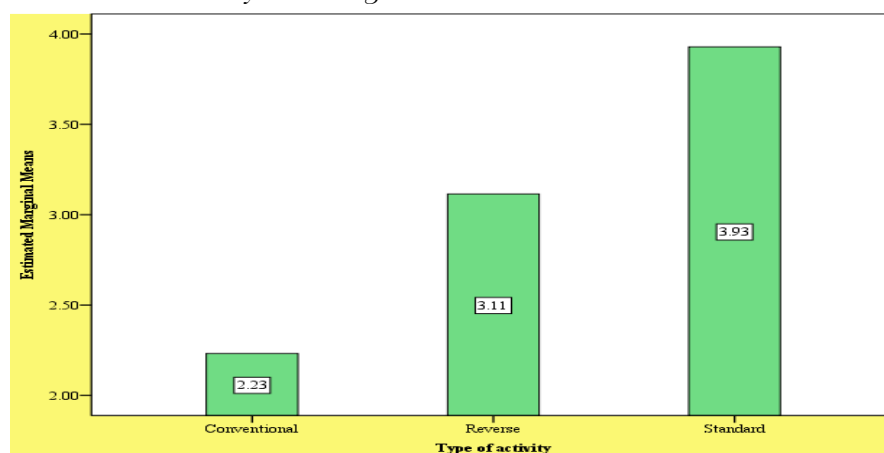
Table 3*Bonferroni Pairwise Comparisons for Formative Vocabulary Learning*

(I) Type	(J) Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Conventional	Reverse	-.883 [*]	.137	.000	-1.229	-.537
	Standard	-1.697 [*]	.139	.000	-2.048	-1.346
Reverse	Standard	-.814 [*]	.144	.000	-1.179	-.449

*. The mean difference is significant at the .05 level.

The pairwise comparisons demonstrated statistically significant differences among all three instructional conditions. Based on the mean scores reported in Table 1, Standard keyword subtitling produced the highest

formative vocabulary learning outcomes, followed by reverse keyword subtitling and conventional condition. Figure 1 also illustrates these differences.

Figure 1*Comparison of ESP Vocabulary Learning Across the Three Instructional Conditions*

To answer the second research question, a repeated-measures ANOVA was conducted to investigate differences among the three instructional conditions regarding long-term

retention of ESP vocabulary. The results of this analysis for addressing the second research question are presented in Table 4.

Table 4*Tests of Within-Subjects Effects for Summative Vocabulary Retention*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Summative Test	Sphericity	22.073	2	11.036	65.141 .000
	Assumed				
	Greenhouse-Geisser	22.073	1.946	11.340	65.141 .000
	Huynh-Feldt	22.073	2.000	11.036	65.141 .000
	Lower-bound	22.073	1.000	22.073	65.141 .000

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Error Sphericity	10.843	64	.169		
(Summative Test) Assumed					
Greenhouse-Geisser	10.843	62.284	.174		
Huynh-Feldt	10.843	64.000	.169		
Lower-bound	10.843	32.000	.339		

Computed using alpha = .05

The ANOVA results indicated a statistically significant difference among the instructional conditions in terms of long-term vocabulary retention, $F(2, 64) = 65.141$, $p < .001$. To provide a clearer understanding of the specific differences among instructional

activities in the summative test scores, pairwise comparisons were conducted using the Bonferroni post hoc test to reduce the likelihood of Type I error.

Table 5

Bonferroni Pairwise Comparisons for Summative Vocabulary Retention

(I) Type	(J) Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Conventional	Reverse	-.633*	.106	.000	-.900	-.366
	Standard	-1.155*	.093	.000	-1.389	-.921
Reverse	Standard	-.522*	.105	.000	-.788	-.256

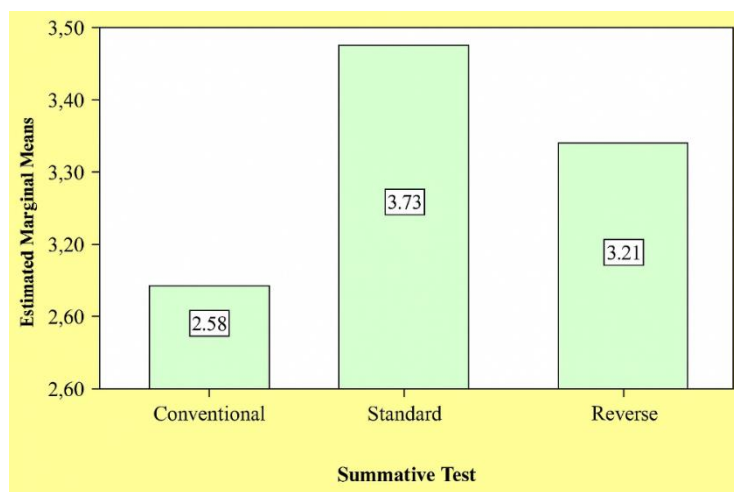
*. The mean difference is significant at the .05 level.

The Bonferroni post hoc comparisons showed significant differences across all instructional conditions. As indicated by the mean scores in Table 1, standard keyword

subtitling resulted in the highest level of long-term vocabulary retention, followed by reverse keyword subtitling and conventional condition. Figure 2 further shows this finding.

Figure 2

Comparison of Long-Term Retention of ESP Vocabulary across the Three Instructional Conditions



To examine learners' attitudes toward the three instructional conditions in line with the third research question, another repeated-

measures ANOVA was conducted. The results are presented in Table 6.

Table 6

Tests of Within-Subjects Effects for Learner Attitudes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Attitude	Sphericity Assumed	67.178	2	33.589	97.517 .000
	Greenhouse-Geisser	67.178	1.575	42.651	97.517 .000
	Huynh-Feldt	67.178	1.643	40.897	97.517 .000
	Lower-bound	67.178	1.000	67.178	97.517 .000
Error (Attitude)	Sphericity Assumed	22.044	64	.344	
	Greenhouse-Geisser	22.044	50.402	.437	
	Huynh-Feldt	22.044	52.564	.419	
	Lower-bound	22.044	32.000	.689	

Computed using alpha = .05

The results demonstrated a statistically significant difference in learners' attitudes toward the three instructional conditions, $F(1.575, 50.402) = 97.517, p < .001$. Because the assumption of sphericity was violated, Greenhouse-Geisser values were interpreted. As shown in Table 7, the pairwise comparisons revealed statistically significant

differences among all three instructional conditions. Based on the mean attitude scores presented in Table 1, participants expressed the most positive attitudes toward standard keyword subtitling, followed by reverse keyword subtitling, whereas conventional condition received the lowest ratings.

Table 7

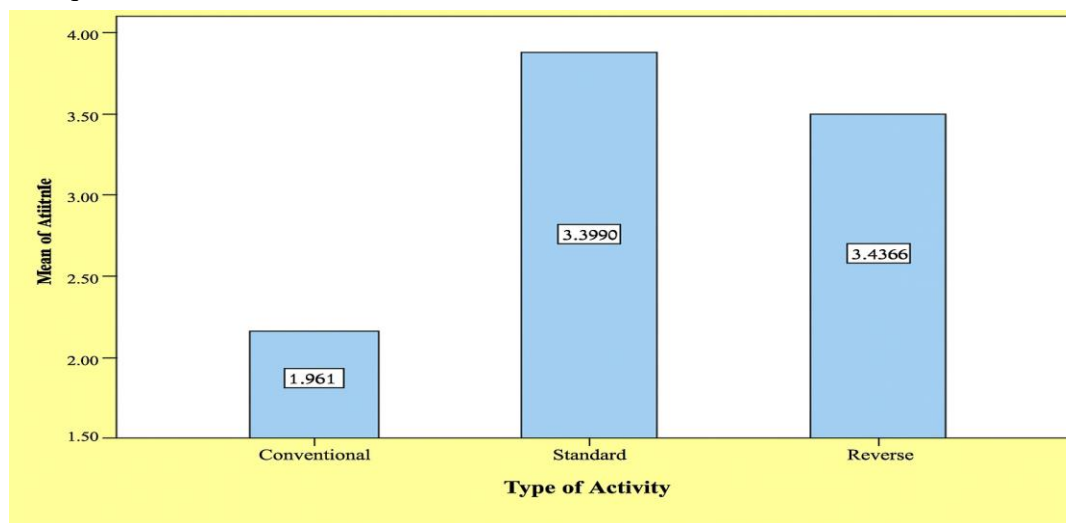
Bonferroni Pairwise Comparisons for Learner Attitudes

(I) Type	(J) Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Conventional	Reverse	-1.475*	.174	.000	-1.915	-1.035
	Standard	-1.930*	.144	.000	-2.294	-1.566
Reverse	Standard	-.455*	.107	.001	-.726	-.183

*. The mean difference is significant at the .05 level.

Figure 3 clearly depicts a statistically significant difference in the perceptions and

attitudes of Iranian engineering students toward the three instructional conditions.

Figure 3*Comparison of Learners' Attitudes Toward the Three Instructional Conditions*

To answer the fourth research question which examined the relationship between learners' attitudes and vocabulary learning and

retention outcomes, Pearson correlation analyses were conducted (see Table 8).

Table 8*Correlations Between Attitude Scores and Vocabulary Outcomes*

Measure		Attitude
Formative Conventional	Pearson Correlation	.116
	Sig. (2-tailed)	.520
Summative Conventional	Pearson Correlation	-.006
	Sig. (2-tailed)	.973
Formative Standard	Pearson Correlation	0.737 [*]
	Sig. (2-tailed)	.000
Summative Standard	Pearson Correlation	0.526 [*]
	Sig. (2-tailed)	.000
Formative Reverse	Pearson Correlation	0.440 [*]
	Sig. (2-tailed)	.000
Summative Reverse	Pearson Correlation	0.381 [*]
	Sig. (2-tailed)	.000

* Correlation is significant at the .05 level.

As shown in Table 8, no statistically significant relationship was found between learners' attitudes toward conventional activities and their vocabulary learning or retention outcomes. In contrast, statistically significant positive correlations emerged between learners' attitudes toward both subtitling conditions and their formative and summative vocabulary scores. The strongest

correlations were observed in the standard keyword subtitling condition, suggesting that more favorable perceptions of subtitling activities were associated with higher vocabulary learning and retention outcomes.

Discussion

The findings of this study revealed a clear hierarchy in the effectiveness of the three

extracurricular vocabulary learning conditions. Standard keyword subtitling produced the highest levels of ESP vocabulary learning and long-term retention, followed by reverse keyword subtitling, whereas conventional vocabulary exercises generated the weakest outcomes. This pattern was consistently observed across both formative and summative assessments. Learners' attitudinal responses reflected these performance trends, with participants reporting significantly more positive perceptions toward standard keyword subtitling and reverse keyword subtitling than toward conventional vocabulary exercises. Moreover, significant positive correlations emerged between learners' attitudes and their performance in the subtitling conditions, indicating the important role of motivational engagement in vocabulary learning.

The superiority of standard keyword subtitling supports previous research emphasizing the effectiveness of didactic subtitling for vocabulary development (e.g., Fuentes-Luque & Campbell, 2020; Lertola, 2012, 2021; McLoughlin & Lertola, 2014). From a theoretical perspective, these findings can be interpreted through the Dual Coding Theory (Paivio, 1986), which suggests that information processed simultaneously through verbal and visual channels is more likely to be retained in long-term memory. Standard keyword subtitling facilitated this dual-channel processing by combining spoken English input with written semantic support, thereby strengthening form-meaning connections and enhancing lexical retention.

The effectiveness of standard didactic subtitling can also be explained through the Cognitive Load Theory (Sweller, 1988). By providing immediate semantic support, standard keyword subtitling reduced extraneous cognitive load and allowed learners

to focus more efficiently on vocabulary comprehension and recognition. In contrast, reverse keyword subtitling required learners to retrieve and produce English equivalents from Persian audiovisual input, increasing cognitive demands related to lexical retrieval, grammatical encoding, and orthographic accuracy. These additional demands likely reduced processing efficiency, particularly for learners with limited experience in subtitling-based production tasks.

Despite being less effective than standard subtitling, reverse subtitling still significantly outperformed conventional vocabulary exercises in both learning and retention. This finding aligns with earlier studies (e.g., Ávila-Cabrera, 2021; Cruz-García, 2021; Talaván et al., 2016) showing that reverse subtitling promotes deeper lexical processing and productive vocabulary use. Unlike conventional vocabulary exercises, reverse subtitling required learners to actively retrieve and apply vocabulary within meaningful audiovisual contexts, supporting deeper semantic processing.

However, several factors may explain why reverse keyword subtitling remained less effective than standard keyword subtitling in the present study. The participants were engineering students rather than language majors and may not have possessed the metalinguistic awareness necessary for managing the cognitive demands of reverse subtitling. Additionally, the extracurricular and self-directed nature of the intervention may have limited opportunities for immediate scaffolding and corrective support. The technological and linguistic complexity of reverse subtitling may also have increased fatigue and reduced learning efficiency over time.

The comparatively weaker performance of conventional vocabulary exercises appears to stem from their limited contextualization and relatively passive learning orientation. Activities such as matching, fill-in-the-blank, and multiple-choice exercises mainly emphasized recognition rather than meaningful language use or contextualized engagement. Unlike subtitling tasks, they lacked multimodal reinforcement and authentic communicative input, which likely resulted in shallower processing and weaker retention. Learners also perceived these activities as less engaging and less relevant than the subtitling tasks.

The delayed retention findings further reinforce the pedagogical value of subtitling-based instruction. Four weeks after the intervention, learners in the standard keyword subtitling condition retained substantially more vocabulary than those in the reverse keyword subtitling and conventional conditions. The combination of auditory input, visual support, contextual meaning, and written subtitles, in line with the Cognitive Theory of Multimedia Learning (Mayer, 2005) and the Dual Coding Theory (Paivio, 1986), likely created multiple retrieval pathways that strengthened long-term memory. Although reverse keyword subtitling condition also enhanced delayed retention compared with conventional activities, its higher cognitive demands may have limited its overall effectiveness relative to standard keyword subtitling.

The attitudinal findings likewise highlight the motivational value of subtitling tasks. Participants viewed both standard keyword subtitling and reverse keyword subtitling more positively than conventional activities, with standard keyword subtitling receiving the strongest motivational support overall. The

authenticity, interactivity, and technological nature of subtitling tasks appeared to increase learner engagement and perceived relevance. The significant correlations between positive attitudes and vocabulary performance in the subtitling conditions further suggest that motivational engagement contributed substantially to learning success. These findings can also be interpreted through Self-Determination Theory (Ryan & Deci, 2000), which emphasizes the importance of autonomy, competence, and meaningful engagement in fostering intrinsic motivation. Overall, the findings strongly support the integration of subtitling-based activities into ESP vocabulary instruction. While both subtitling conditions proved beneficial, standard keyword subtitling emerged as the most effective and pedagogically accessible approach for Iranian engineering students because it balanced multimodal reinforcement with manageable cognitive demands and high motivational appeal.

The findings of this study suggest several important implications for ESP instruction. Standard subtitling should be incorporated into ESP vocabulary teaching as an effective pedagogical tool for enhancing vocabulary learning and retention through multimodal reinforcement. Reverse subtitling may likewise function as a valuable instructional activity by encouraging productive vocabulary use and deeper lexical processing. Nevertheless, because of its higher cognitive demands, learners may benefit from additional scaffolding, including glossaries, guided practice, and teacher support, to engage with the activity more effectively. The findings additionally highlight the pedagogical value of integrating authentic discipline-specific audiovisual materials into ESP curricula, as engineering-related videos enabled learners to

connect language learning with their academic and professional interests, thereby increasing engagement and perceived relevance. Furthermore, the successful implementation of subtitling activities through digital platforms suggests that technology-mediated vocabulary learning can extend language exposure beyond classroom settings and promote greater learner autonomy. These findings also imply that ESP curriculum designers and teacher education programs should provide greater emphasis on audiovisual translation tasks and technology-enhanced instructional practices to support more contextualized, interactive, and learner-centered vocabulary instruction.

Conclusion

The findings clearly demonstrated that both subtitling approaches significantly enhanced vocabulary learning outcomes compared with conventional activities, with standard keyword subtitling emerging as the most effective instructional condition overall. The superiority of standard keyword subtitling appears to derive from its combination of multimodal reinforcement, reduced cognitive load, contextualized audiovisual input, and strong motivational appeal. Reverse keyword subtitling also proved pedagogically valuable by encouraging deeper lexical processing and productive vocabulary use, although its effectiveness was somewhat constrained by its higher cognitive demands. Conventional vocabulary exercises, while useful for basic reinforcement, were less successful in fostering meaningful engagement and long-term retention.

By demonstrating the advantages of subtitling-based instruction within an ESP context, this study contributes to the growing literature supporting the integration of audiovisual translation tasks into language

education. The findings underscore the pedagogical value of multimodal, technology-enhanced, and task-based approaches for promoting deeper vocabulary learning and more engaging educational experiences. Overall, the study highlights the importance of aligning instructional design with learners' cognitive capacities, motivational needs, and disciplinary interests when implementing innovative vocabulary learning practices in ESP contexts.

Limitations and Future Research

Several limitations should be acknowledged. The study involved a relatively small sample of Iranian engineering students with prior subtitling experience, which may limit the generalizability of the findings. Additionally, the instructional materials focused exclusively on engineering-related vocabulary. Future research should examine subtitling-based vocabulary instruction across different disciplines, proficiency levels, and educational contexts. Longitudinal studies with larger and more diverse samples could provide deeper insight into the long-term effects of subtitling on vocabulary development and other language skills. Further research may also investigate the role of scaffolding, technological familiarity, and AI-assisted subtitling tools in optimizing subtitling-based language learning.

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