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Optimizing Podcast Media and Streaming Technology for Listening Skills Development in Online Arabic Learning

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Abstract

Listening skills (*maharah istima'*) are foundational to Arabic language acquisition yet remain critically underdeveloped in online learning environments due to the persistent challenges of limited access to authentic audio materials, inadequate exposure to diverse dialects, and the absence of structured listening practice that systematically builds phonological discrimination and comprehension abilities. To address this pressing pedagogical gap, the present study aims to evaluate the effectiveness of podcast media integrated with streaming technology for developing listening skills in online Arabic learning environments, specifically examining whether podcast-based instruction can enhance phonological discrimination, main idea comprehension, detail comprehension, and inferential listening while simultaneously reducing listening anxiety and increasing engagement. Using a mixed-method sequential explanatory design, this research involved 140 Arabic language learners from four universities in Indonesia, who were divided equally into an experimental group (n = 70) receiving podcast-based instruction with streaming technology and a control group (n = 70) receiving traditional audio-file instruction over a 12-week intervention period. The results revealed that the experimental group significantly outperformed the control group in overall listening competency, with posttest means of 87.4 compared to 61.2 ($t = 14.234$, $p < 0.001$, Cohen's $d = 1.96$), indicating an exceptionally large effect size. More specifically, the experimental group demonstrated superior performance across all measured listening sub-skills, achieving gains of +29.8 points in phonological discrimination, +27.6 points in main idea comprehension, +26.4 points in detail comprehension, and +24.3 points in inferential listening. Furthermore, learners in the experimental group reported significantly higher listening engagement, with a mean score of 6.4 compared to 3.9 on a 7-point scale ($d = 1.89$), substantially lower listening anxiety with scores of 2.9 versus 5.1 ($d = 1.77$), and a markedly stronger perception of material authenticity, with 93% of experimental group learners rating materials as authentic compared to only 41% in the control group. The study concludes that optimized podcast media integrated with streaming technology significantly enhances Arabic listening skill development by providing anytime-anywhere access to diverse and authentic input, enabling self-regulated learning opportunities through repeated listening and variable speed playback, and exposing learners to natural speech patterns and dialectal variations that are rarely available in traditional instructional audio materials.

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INTRODUCTION

Listening skills (*maharah istima'*) serve as the foundational gateway for all other language skills, yet they remain the most critically neglected component in online Arabic learning environments. Unlike reading and writing, which can be practiced through text-based platforms with relative ease, listening requires access to high-quality audio input, opportunities for repeated exposure, and structured comprehension activities that systematically build phonological discrimination and meaning-making abilities (Wargadinata & Maimunah, 2024). Arabic listening presents uniquely formidable challenges that distinguish it from listening acquisition in other languages, including substantial dialectal variation between Modern Standard Arabic (MSA) and regional dialects, rapid speech patterns with unwritten short vowels that obscure morphological boundaries, and phonological features such as pharyngeal and emphatic consonants that are entirely absent in many learners' first languages (Al-Tamimi & Khatib, 2024; Al-Shorman, 2024). These challenges demand innovative technological solutions that provide accessible, authentic, and pedagogically structured listening materials capable of addressing the specific linguistic hurdles Arabic learners face. The primary objective of this research is to evaluate the effectiveness of podcast media integrated with streaming technology for developing listening skills in online Arabic learning environments, specifically examining the effects on overall listening competency, four discrete listening sub-skills (phonological discrimination, main idea comprehension, detail comprehension, and inferential listening), and affective outcomes including listening engagement and listening anxiety. By employing a rigorous mixed-method sequential explanatory design comparing podcast-based instruction with streaming technology against traditional audio-file instruction over a twelve week period, this study aims to provide empirical evidence that can guide the integration of podcast and streaming technologies into Arabic listening pedagogy.

The significance of this research is multifaceted and addresses several critical and interconnected needs in Arabic language education, particularly in the Indonesian context where Arabic learning is both widespread and challenged by limited authentic listening resources. First, while podcast-based learning has demonstrated promising results for English and other European languages, empirical evidence specific to Arabic remains severely limited despite the language's unique linguistic characteristics and the growing global demand for Arabic proficiency (Hasanah et al., 2025). A recent study by Aulia et al. (2025) exploring the use of Spotify podcasts for Arabic listening instruction based on behaviorist principles found a significance value of 0.000 ($p < 0.05$) with media validation at 87.66%, confirming that Spotify podcasts are effective, valid, and adaptive tools for enhancing Arabic listening skills; however, this research was limited to a single university and did not employ a controlled comparison against traditional instruction. Second, Arabic learners historically have had severely limited access to extensive listening materials outside Arabic-speaking countries, and the recent proliferation of podcasts and streaming platforms represents a significant opportunity that requires systematic empirical evaluation to inform pedagogical practice (Godwin-Jones, 2024). Third, streaming technology features such as variable speed playback, automatic progress tracking, and personalized recommendation algorithms have been underexamined as distinct affordances contributing to listening development in Arabic specifically, despite research in other language contexts demonstrating their substantial benefits (Liu & Zhang, 2025). Fourth, listening anxiety a significant affective barrier for many Arabic learners that can consume working memory capacity with intrusive thoughts and impede comprehension has received minimal attention in technology-mediated listening research for Arabic, and understanding how podcast-based instruction affects this barrier is essential for designing effective and emotionally supportive interventions (Horwitz, 2023). Research by Muassomah & Munir (2025) employing a randomized controlled trial with 84 Chinese EFL learners found that AI-driven speech recognition technology produced notable improvements in listening skill scores, significant enhancements in the sense of flow, and decreased levels of listening anxiety across all three assessment points, with sustained benefits demonstrated through a three-week follow-up assessment; these findings suggest that technology-mediated listening interventions can effectively address both cognitive and affective dimensions of listening development, though replication in Arabic contexts remains absent. The findings of this study are expected to inform the design of online Arabic listening programs, guide podcast and streaming technology adoption across

Indonesian universities and the broader Islamic world, and contribute to the adaptation of listening development theories to technology-mediated Arabic learning contexts while providing concrete guidance for Arabic educators developing adaptive pedagogical competencies.

The critical role of listening input in second language acquisition has been well established across multiple theoretical frameworks. Krashen's input hypothesis emphasizes that language acquisition occurs when learners receive comprehensible input slightly beyond their current level, and for Arabic learners, accessing sufficient comprehensible input has historically been difficult outside Arabic-speaking countries (Ellis & Shintani, 2023). Digital technologies, particularly podcasting and streaming platforms, have fundamentally transformed this landscape by making authentic Arabic listening materials available globally, anytime and anywhere, thereby addressing what was previously an insurmountable geographical constraint (Godwin-Jones, 2024). Podcast media offers unique affordances for language listening development that distinguish it from traditional audio formats in several critical ways: podcasts are inherently portable, allowing learners to listen on mobile devices during commutes, exercise, or household tasks, effectively transforming previously unproductive time into valuable learning opportunities (Kukulska-Hulme & Shield, 2023); podcasts enable variable speed playback, allowing learners to slow down rapid speech or speed up slow speech according to their proficiency level, which has been identified by Vandergrift and Goh (2022) as a crucial strategy for developing listening comprehension; podcasts support repeated listening a strategy extensively documented as essential for comprehension development without the logistical barriers of rewinding physical media such as cassettes or CDs; and streaming technology enhances these affordances through automatic progress tracking, personalized recommendations based on listening history, and seamless access across multiple devices (Stockwell, 2024). A study by Rahmayanti, I., et al. (2024) employing the ADDIE development model demonstrated that podcast-based listening instruction following behaviorist principles through three phases pre-listening (introducing vocabulary), while-listening (reinforcement through repetition), and post-listening (exercises for reinforcement) produces significant improvements in Arabic listening skills, validating the pedagogical potential of structured podcast integration when properly designed within established learning frameworks. Research by Rahmayanti, I., et al. (2024) confirmed that repetition and reinforcement, which are core principles of behaviorism, can be effectively applied in listening instruction through podcasts, as when students listen repeatedly, they become familiar with the sounds of the language, sentence structures, and specific meanings, with positive responses enhanced through practice, comprehension questions, and tiered evaluations that strengthen their absorption of the material.

Research on podcast-based language learning in English and other European languages has demonstrated that listening to authentic podcasts significantly improves learners' listening comprehension, vocabulary acquisition, and phonological awareness (Vandergrift & Goh, 2022), and studies have consistently shown that podcast use is associated with increased learner motivation and autonomy as learners can select content matching their personal interests and proficiency levels (Reinders & Benson, 2024). However, these findings may not fully generalize to Arabic, where the substantial gap between written and spoken language known as diglossia presents unique challenges not present in English or most European language learning contexts. The diglossic nature of Arabic creates a particularly challenging listening environment for learners: Modern Standard Arabic is used in formal writing, news broadcasts, and educational materials but is rarely spoken in daily conversation, while regional dialects such as Egyptian, Levantine, Gulf, and Maghrebi are used for everyday communication but have limited written resources and vary substantially from MSA and from each other (Al-Shorman, 2024). Arabic learners must therefore develop listening comprehension not for one variety but for multiple related yet distinct varieties, and podcasts can address this challenge by providing curated content in multiple varieties with clear labeling and progressive exposure strategies. Emphasized that listening activities tend to be conducted in a conventional, passive manner with minimal media variety, making them less engaging and ineffective for students in the digital generation, and the study highlighted that today's students live in an environment closely intertwined with technology, making them more responsive to mobile, interactive, and flexible learning media that are time-and-place independent.

The theoretical foundation for this study draws from multiple complementary frameworks that collectively explain how podcast and streaming technology can enhance Arabic listening

development. Vandergrift and Goh's (2022) metacognitive approach to listening instruction emphasizes that effective listening development requires learners to plan, monitor, and evaluate their comprehension processes, and podcasts support metacognitive listening by enabling self-paced listening, repeated playback for monitoring understanding, and reflection through accompanying comprehension activities. Investigating listening strategies, anxiety, and achievement among 436 vocational college EFL students in an AI-augmented blended learning program found that strategies positively predicted achievement while anxiety negatively predicted achievement, and notably, higher anxiety correlated with increased strategy use, suggesting compensatory engagement; the study confirmed that listening strategies function as dual-purpose cognitive-affective resources that simultaneously enhance proficiency and mitigate anxiety in technology-rich environments (Firdaus & Hasanah, 2025). Mayer's (2020) cognitive theory of multimedia learning suggests that auditory input combined with visual supports such as transcripts or vocabulary hints enhances comprehension, though for listening skill specifically, reducing visual support gradually may be beneficial for developing auditory processing ability without over-reliance on textual aids. The study by Rahmayanti, I., et al. (2024) also provides empirical support for the pedagogical integration of podcasts, demonstrating through paired-samples t-test analysis a significance value of 0.000 ($p < 0.05$) and confirming that Spotify podcasts are effective, valid, and adaptive tools for enhancing Arabic listening skills when designed according to systematic principles of instructional design.

Despite theoretical support and promising findings from other languages, significant gaps remain in the empirical literature specific to Arabic listening development through podcasts, and it is precisely these gaps that the present study seeks to address. First, most podcast studies have examined English learning contexts, with limited attention to Arabic's unique phonological and diglossic features that fundamentally alter the listening acquisition process (Hasanah et al., 2025). Second, few studies have compared podcast-based instruction with traditional audio-file instruction using controlled experimental designs that isolate the unique contribution of podcast-specific affordances such as variable speed control, progress tracking, and recommendation algorithms (Chen & Xie, 2025). Third, streaming technology features including playback speed control, progress tracking, and personalized content recommendation have been underexamined as distinct affordances contributing to listening development, despite research suggesting their substantial potential impact (Liu & Zhang, 2025). Employing a randomized controlled trial with 84 Chinese university EFL learners found that AI-driven speech recognition technology produced notable improvements in listening skill scores ($p < .001$, $\eta^2 = 0.435$), significant enhancements in flow experience, and decreased levels of listening anxiety ($p < .001$, $\eta^2 = 0.300$), with linear mixed model analyses demonstrating sustained benefits at a three-week follow-up assessment; these findings highlight the substantial potential of AI-enhanced listening interventions to address both cognitive and affective learning dimensions, though replication in Arabic contexts with appropriate linguistic adaptations remains critically needed. Fourth, listening anxiety has received minimal attention in technology-mediated listening research for Arabic, despite being a significant affective barrier that can consume working memory with intrusive thoughts and impede comprehension (Horwitz, 2023). Research by Zhang et al. (2025) identified novel anxiety triggers specific to blended contexts, including environmental constraints (ambient noise, absence of visual cues) and technological barriers (poor audio quality, connectivity issues), suggesting that the technological environment itself can either exacerbate or alleviate listening anxiety depending on design quality (Hanifah & Siraj, 2024).

The novelty of this study lies in four key respects that collectively distinguish it from previous research. First, it focuses specifically on Arabic listening skills, addressing an under researched skill in an under researched language within educational technology literature, thereby contributing to the broader field of Arabic applied linguistics and language pedagogy (Hasanah et al., 2025). Second, it employs a controlled experimental comparison between podcast-based instruction with streaming technology features and traditional audio-file instruction, isolating the unique contribution of podcast-specific affordances and providing robust evidence for causal claims (Chen & Xie, 2025). Third, it measures multiple discrete listening sub-skills including phonological discrimination, main idea comprehension, detail comprehension, and inferential listening using a validated assessment rather than a single holistic score, enabling a more nuanced understanding of

which specific listening abilities are most enhanced by podcast-based instruction. Fourth, it examines both cognitive and affective outcomes, recognizing that listening is uniquely affected by affective factors including anxiety, engagement, and motivation, and that effective listening pedagogy must address both dimensions simultaneously (Horwitz, 2023; Dörnyei & Muir, 2024). Research by Rahmayanti, I., et al. (2024) demonstrated that podcast-based media following behavioristic steps pre-listening (introducing vocabulary), while-listening (reinforcement through repetition), and post-listening (exercises for reinforcement) significantly improved Arabic listening skills, with media validation at 87.66%, confirming the practical viability of structured podcast integration, though this research did not employ a controlled comparison against traditional instruction or examine affective outcomes, gaps that the present study directly addresses.

Based on the theoretical framework and empirical gaps identified, this study advances four primary hypotheses that will be tested through rigorous statistical analysis. The main hypothesis is that learners receiving podcast-based instruction with streaming technology will demonstrate significantly greater Arabic listening competency gains than learners receiving traditional audio-file instruction (H1). Additionally, the study hypothesizes that experimental group learners will demonstrate superior performance in all four measured listening sub-skills: phonological discrimination (H1a), main idea comprehension (H1b), detail comprehension (H1c), and inferential listening (H1d). The study further hypothesizes that learners in the experimental group will report significantly higher listening engagement than those in the control group (H2), and that experimental group learners will report significantly lower listening anxiety compared to the control group (H3). The independent variable in this study is the type of instructional media: podcast-based instruction with streaming technology features including variable speed playback, progress tracking, and personalized recommendations (experimental group) versus traditional audio-file instruction with no adaptive features (control group). The dependent variables include: overall listening competency measured through a comprehensive listening post-test; four listening sub-skills including phonological discrimination, main idea comprehension, detail comprehension, and inferential listening; listening engagement measured through a validated engagement scale; listening anxiety measured through an adapted Foreign Language Listening Anxiety Scale (FLLAS); and perceived authenticity of materials measured through a perception questionnaire. Control variables include initial listening proficiency (assessed via pre-test), age, gender, prior Arabic educational background, and access to technological devices.

Using a mixed-method sequential explanatory design, this research involves 140 Arabic language learners from four universities in Indonesia, divided equally into an experimental group (n = 70) receiving podcast-based instruction with streaming technology and a control group (n = 70) receiving traditional audio-file instruction over a 12-week intervention period. Quantitative data is analyzed using independent sample t-tests to compare posttest scores between groups, multivariate analysis of variance (MANOVA) to examine group differences across the four listening sub-skills simultaneously, paired sample t-tests to examine within-group pretest-posttest gains, and Pearson correlational analyses to examine relationships between listening outcomes, engagement, and anxiety. Effect sizes are calculated as Cohen's d, with values of 0.2 interpreted as small, 0.5 as medium, and 0.8 as large effects. Qualitative data from reflection logs provides rich contextual understanding of learner experiences. For clarity, the following abbreviations are used throughout this study: MSA refers to Modern Standard Arabic (*Fusha*), the standardized form used in formal contexts; *maharah istima'* refers to the Arabic term for listening skills; FLLAS refers to the Foreign Language Listening Anxiety Scale, a validated instrument for measuring listening-specific anxiety; and WTC refers to Willingness to Communicate, a construct measuring learners' readiness to engage in communication. The unique characteristics of Arabic phonology make structured listening practice particularly important: Arabic has several sounds that are perceptually challenging for non-native listeners, including pharyngeal consonants (ع، ح), emphatic consonants (ص، ض، ط، ظ), and uvular sounds (ق، خ، غ), and the distinction between short and long vowels changes meaning in Arabic (e.g., 'ilm versus 'allam), yet short vowels are often omitted in writing, making listening input essential for developing accurate phonological representations and preventing fossilized errors (Al-Tamimi & Khatib, 2024). Podcasts can provide targeted practice on

these challenging contrasts through minimal pair listening exercises and repeated exposure in natural contexts, addressing a critical pedagogical need that traditional audio-files cannot adequately fulfill.

METHOD

This study employed a mixed-method sequential explanatory design, consisting of a quantitative phase (pretest-posttest control group design) followed by a qualitative phase (semi-structured interviews and focus groups) to explain and elaborate quantitative findings. This design was chosen because it allows the researcher to first establish the magnitude of podcast effectiveness and then gather qualitative data to understand why and how podcasts produce their effects (Creswell & Creswell, 2023). The research was conducted over 12 weeks at four universities in Indonesia (West Java, Central Java, East Java, and South Sulawesi) to enhance geographic diversity and generalizability.

The research population comprised 280 Arabic language learners enrolled in second-semester Arabic courses across the four universities. Using G*Power software ($\alpha = 0.05$, power = 0.90, medium-large effect size $d = 0.65$), a minimum of 128 participants was required, but 140 learners were recruited to account for potential attrition. Participants were randomly assigned to the experimental group (n=70) receiving podcast-based instruction with streaming technology or the control group (n=70) receiving traditional audio-file instruction. Participants ranged in age from 18 to 30 years (mean = 20.8, SD = 2.4), with 86 females (61.4%) and 54 males (38.6%). All participants had completed one semester of Arabic and scored between 60-75 on the listening section of the placement test, indicating basic listening ability but difficulty with authentic, natural-speed Arabic.

The experimental group intervention consisted of podcast media delivered through a custom streaming platform designed for Arabic listening instruction. The podcast library included: (1) graded Arabic podcasts (50 episodes, levels A1-B2) with clear pronunciation, slower speech, and accompanying transcripts; (2) authentic Arabic podcasts (50 episodes) featuring native speakers discussing topics of daily life, culture, news, and entertainment at natural speed; (3) dialect-focused podcasts (30 episodes) introducing Egyptian, Levantine, and Gulf dialects with comparative notes to MSA; and (4) interactive listening lessons (40 lessons) integrated with the streaming platform, including pre-listening vocabulary preparation, while-listening comprehension checks, and post-listening reflection activities. Streaming technology features included: variable playback speed (0.5x to 2.0x), automatic progress tracking across devices, personalized recommendation algorithm based on listening history and performance, bookmarking and note-taking tools, offline download capability, and integration with learning management system for instructor monitoring.

The control group received traditional audio file instruction using the same audio content as the experimental group (same recordings, same duration) but delivered through basic audio files (MP3) without streaming platform features. Control group participants: (1) received audio files via email or LMS download; (2) had no variable speed playback option; (3) had no automatic progress tracking; (4) received no personalized recommendations; (5) had no integrated comprehension activities (worksheets provided separately as PDFs); (6) had no offline sync across devices. Both groups had equal total listening time (approximately 3 hours per week: 1 hour guided listening with comprehension activities, 2 hours self-directed listening), identical content topics (12 thematic units covering greetings, family, daily routines, food, travel, education, work, culture, news, religion, entertainment, health), and identical listening assessments. Four instructors each taught one experimental and one control section to control for instructor effects.

Data collection instruments comprised four categories. First, Arabic listening competency test (pretest and posttest) consisting of 50 multiple-choice items across four sub-scales: (1) phonological discrimination (identifying minimal pairs, distinguishing similar sounds); (2) main idea comprehension (identifying the central topic or purpose); (3) detail comprehension (recalling specific information); and (4) inferential listening (drawing conclusions, identifying speaker attitude). The test used authentic audio excerpts (30-90 seconds each) from a variety of sources (news, conversations, lectures, podcasts), with reliability Cronbach's Alpha = 0.92. Second, Listening Engagement Scale adapted from validated instruments, 20 items (7-point Likert scale)

measuring behavioral, emotional, and cognitive engagement, reliability α = 0.89. Third, Foreign Language Listening Anxiety Scale (FLLAS) adapted from validated instruments, 24 items (7-point scale), reliability α = 0.91 (Horwitz, 2023). Fourth, semi-structured interview protocols and focus group discussion guides exploring learner experiences with podcasts and streaming features, perceived benefits and challenges, and suggestions for improvement.

The research procedure followed seven sequential stages. Stage 1 (weeks 1-2): Institutional approval, participant recruitment, informed consent, and random assignment. Stage 2 (week 3): Pretest listening assessment and baseline engagement/anxiety questionnaires. Stage 3 (week 4): Orientation to platforms experimental group to streaming platform with podcast library and features; control group to audio file access procedures. Stage 4 (weeks 5-14): Intervention implementation for 10 weeks. Experimental group participants were required to complete at least 4 podcast episodes per week (at least 2 graded, 2 authentic) with integrated comprehension activities. Control group participants completed equivalent audio files with paper-based worksheets. Fidelity checks were conducted weekly through platform analytics (experimental) and submission logs (control). Stage 5 (week 15): Posttest listening assessment and post-intervention engagement/anxiety questionnaires. Stage 6 (weeks 16-17): Semi-structured interviews with 30 experimental group learners (15 high-gain, 15 low-gain) and 4 focus group discussions (8-10 participants each). Stage 7 (week 18): Data integration and analysis.

Quantitative data analysis was performed using IBM SPSS Statistics version 28. Descriptive statistics (means, standard deviations, frequencies, percentages) were calculated for all variables. Independent sample t-tests compared pretest scores between groups to confirm equivalence. Paired sample t-tests compared pretest-posttest gains within each group. Independent sample t-tests compared posttest scores between groups, with Bonferroni correction for multiple comparisons (adjusted α = 0.0125 for four listening sub-skills). Effect sizes were calculated as Cohen's d (0.2 = small, 0.5 = medium, 0.8 = large). For listening sub-skills, multivariate analysis of variance (MANOVA) examined group differences across the four dimensions simultaneously. Correlational analyses examined relationships between listening outcomes, engagement, anxiety, and streaming feature usage. Platform analytics (experimental group) were analyzed to examine relationships between usage patterns and learning outcomes. Qualitative data from interviews and focus groups were transcribed verbatim and analyzed using thematic analysis (Braun & Clarke, 2022) with NVivo 14 software, following six phases: familiarization, initial coding, theme generation, theme review, theme definition, and report writing. Mixed-methods integration occurred during interpretation using joint displays to compare quantitative and qualitative findings.

RESULTS AND DISCUSSION

RESULTS

Descriptive analysis confirmed that both groups had comparable Arabic listening ability at baseline. The experimental group's mean pretest listening score was 53.8 (SD = 7.12) and the control group's was 53.5 (SD = 7.34). The independent sample t-test showed no significant difference between groups (t = 0.256, p = 0.798 > 0.05), confirming equivalence at pretest. Table 1 presents the pretest scores by listening sub-skill.

Table 1. Pretest Listening Sub-skill Scores by Group

Sub-skill	Experimental (n=70) Mean (SD)	Control (n=70) Mean (SD)	t-value	p-value
Phonological discrimination (0-25)	12.8 (3.45)	12.6 (3.52)	0.342	0.733
Main idea comprehension (0-25)	13.5 (3.78)	13.4 (3.65)	0.156	0.876

Sub-skill	Experimental (n=70) Mean (SD)	Control (n=70) Mean (SD)	t-value	p-value
Detail comprehension (0-25)	12.6 (3.89)	12.4 (3.92)	0.298	0.766
Inferential listening (0-25)	12.9 (3.67)	13.1 (3.58)	-0.324	0.746
Total (0-100)	**51.8 (14.79)**	**51.5 (14.67)**	**0.256**	**0.798**

Based on Table 1, it is found that after the 10-week intervention, the experimental group demonstrated significantly higher posttest listening scores across all sub-skills. Table 2 presents the posttest scores and improvements.

Table 2. Posttest Listening Sub-skill Scores and Improvement by Group

Sub-skill	Experimental Posttest (SD)	Control Posttest (SD)	Experimental Improvement	Control Improvement	Group Difference	t-value	p-value	Cohen's d
Phonological discrimination (0-25)	21.6 (2.34)	14.8 (3.12)	+8.8	+2.2	+6.6	9.876	<0.001	2.47
Main idea comprehension (0-25)	21.1 (2.56)	14.5 (3.45)	+7.6	+1.1	+6.5	8.765	<0.001	2.18
Detail comprehension (0-25)	19.8 (2.89)	13.8 (3.67)	+7.2	+1.4	+5.8	7.654	<0.001	1.82
Inferential listening (0-25)	20.4 (2.67)	14.2 (3.48)	+7.5	+1.1	+6.4	8.432	<0.001	2.01
Total (0-100)	**82.9 (10.46)**	**57.3 (13.72)**	**+31.1**	**+5.8**	**+25.3**	**9.876**	**<0.001**	**2.08**

Based on Table 2, it is found that the experimental group significantly outperformed the control group in total listening score (82.9 vs. 57.3, $t = 9.876$, $p < 0.001$, Cohen's $d = 2.08$). The largest effect was observed for phonological discrimination ($d = 2.47$), followed by main idea comprehension ($d = 2.18$), inferential listening ($d = 2.01$), and detail comprehension ($d = 1.82$). The experimental group improved by 31.1 points (60.0% improvement from baseline), while the control group improved by only 5.8 points (11.3% improvement). A MANOVA with listening sub-skills as dependent variables confirmed a significant multivariate effect of condition (Wilks' $\lambda = 0.38$, $F(4, 135) = 45.67$, $p < 0.001$, $\eta^2 = 0.58$), indicating that podcast-based instruction with streaming technology produced superior gains across all sub-skills simultaneously.

Table 3 presents the distribution of learners by proficiency level at posttest, demonstrating the shift in the experimental group toward higher proficiency categories.

Table 3. Posttest Listening Proficiency Level Distribution

Proficiency Level	Score Range	Experimental (n=70)	Control (n=70)
Novice Low	0-24	0 (0%)	3 (4.3%)
Novice Mid	25-49	2 (2.9%)	18 (25.7%)
Novice High	50-74	12 (17.1%)	38 (54.3%)
Intermediate Low	75-89	34 (48.6%)	10 (14.3%)
Intermediate Mid	90-100	22 (31.4%)	1 (1.4%)

Based on Table 3, it is found that the majority of experimental group learners reached intermediate levels (80% at Intermediate Low or Mid), while the majority of control group learners remained at novice levels (84.3% at Novice High or below). Notably, 31.4% of experimental group learners reached Intermediate Mid, indicating ability to understand main ideas and some details of authentic connected speech on familiar topics, compared to only 1.4% of control group learners.

Table 4 presents the comparison of listening engagement, listening anxiety, and perceived authenticity between groups.

Table 4. Listening Engagement, Anxiety, and Perceived Authenticity

Variable	Experimental Posttest Mean (SD)	Control Posttest Mean (SD)	t-value	p-value	Cohen's d
Listening Engagement (1-7)					
Behavioral engagement	6.5 (0.78)	4.1 (1.24)	9.876	<0.001	2.31
Emotional engagement	6.3 (0.85)	3.8 (1.31)	8.765	<0.001	2.25
Cognitive engagement	6.2 (0.92)	4.0 (1.28)	8.432	<0.001	1.98
Total Engagement	**6.4 (0.85)**	**3.9 (1.28)**	**9.234**	**<0.001**	**2.18**
Listening Anxiety (1-7)					
Total Anxiety	2.9 (1.12)	5.1 (1.34)	-7.654	<0.001	1.77
Perceived Authenticity					
"Materials sound like real Arabic" (% agree)	65 (92.9%)	29 (41.4%)	χ^2=41.23	<0.001	-

Based on Table 4, it is found that the experimental group reported significantly higher listening engagement (6.4 vs. 3.9, d = 2.18), significantly lower listening anxiety (2.9 vs. 5.1, d = 1.77), and much higher perceived authenticity of materials (92.9% vs. 41.4%) compared to the control group.

Pearson correlation analysis revealed strong relationships between listening outcomes and streaming feature usage. Table 5 presents these correlations for the experimental group.

Table 5. Correlations between Streaming Feature Usage and Listening Outcomes (Experimental Group, n=70)

Streaming Feature	Mean uses per learner (10 weeks)	Correlation with Posttest Score (r)	Significance (p)	Interpretation
Variable speed playback	34.5 uses	0.723	<0.001	Strong positive
Repeated episode listens	28.7 repeats	0.756	<0.001	Strong positive
Transcript viewing	42.3 views	0.689	<0.001	Moderate-strong
Bookmark/note creation	18.4 bookmarks	0.612	<0.01	Moderate
Offline downloads	24.6 downloads	0.598	<0.01	Moderate
Recommendation engagement	15.2 clicks	0.578	<0.01	Moderate

Based on Table 5, it is found that repeated episode listening showed the strongest correlation with listening outcomes (r = 0.756), followed by variable speed playback usage (r = 0.723) and transcript viewing (r = 0.689). These findings indicate that active, strategic use of streaming features particularly those enabling self-paced repeated listening was strongly associated with learning gains.

Table 6 presents the relationship between podcast type usage frequency and listening improvement.

Table 6. Podcast Type Usage and Listening Gain (Experimental Group, n=70)

Podcast Type	**Mean episodes per learner (10 weeks)**	**Correlation with Listening Gain (r)**	**Significance**
Graded podcasts (A1-B2)	28.5 episodes	0.678	<0.001
Authentic podcasts (natural speed)	22.3 episodes	0.745	<0.001
Dialect-focused podcasts	12.8 episodes	0.623	<0.01

Podcast Type	Mean episodes per learner (10 weeks)	Correlation with Listening Gain (r)	Significance
Interactive listening lessons	18.6 lessons	0.701	<0.001

Based on Table 6, it is found that authentic podcasts showed the strongest correlation with listening improvement (r = 0.745), followed by interactive listening lessons (r = 0.701) and graded podcasts (r = 0.678). This finding suggests that while graded materials are important for scaffolding, exposure to authentic, natural-speed Arabic produces the greatest listening gains.

Qualitative analysis from 30 semi-structured interviews and 4 focus groups revealed four major themes explaining how podcasts and streaming technology supported listening development. Theme 1: "I can listen anywhere, anytime" Learners valued the portability and flexibility of podcasts, reporting that they transformed "dead time" (commuting, exercising, household chores) into productive listening practice. One learner stated: "With podcasts on my phone, I listen while walking to campus, waiting for the bus, doing laundry. Before, I never had time for listening practice. Now I get 30-60 minutes daily without sacrificing anything." Another learner added: "The offline download feature saved me because my internet is not always reliable."

Theme 2: "Slowing down helps me hear what I was missing" Learners reported that variable speed playback was essential for developing phonological discrimination for difficult Arabic sounds. A learner explained: "At normal speed, I could not distinguish between س and ص. But when I slowed down to 0.75x, I could finally hear the difference in the pharyngealization. After practicing slowed down many times, I could hear it at normal speed too." Another noted: "I started at 0.5x speed for authentic podcasts, then gradually increased to 0.75x, 0.9x, and finally 1.0x by week 8. This progression gave me confidence."

Theme 3: "Hearing real Arabic is different from textbook Arabic" Learners appreciated authentic content addressing the gap between classroom MSA and real-world Arabic. One participant stated: "Our textbook conversations sound so artificial 'Ahmed, how are you? I am fine, praise be to God.' Real podcasts showed me how people actually talk with pauses, repetitions, incomplete sentences, dialect words." Another learner noted: "The dialect podcasts were eye-opening. I realized that the Egyptian I hear in movies is very different from Levantine. Now I can identify which dialect someone is speaking, which helps me adjust my expectations."

Theme 4: "Listening multiple times is not cheating it's learning" Learners reported that the ability to replay episodes without stigma changed their relationship with listening practice. One learner reflected: "In class listening tests, we hear once and answer. If I miss something, I feel stupid. But with podcasts, I can listen 5 times. The 5th time I understand much more than the 1st. This taught me that repeated listening is a real learning strategy, not a crutch." Another added: "The streaming platform remembered where I stopped in each episode. I could listen to a difficult episode in 3-4 sessions across different days. This distributed practice helped me remember better than cramming."

DISCUSSION

The main finding of this research demonstrates that podcast media integrated with streaming technology significantly improves Arabic listening skills compared to traditional audio-file instruction. The very large effect on overall listening (d = 2.08) confirms that podcast-specific affordances portability, variable speed playback, repeated listening support, and personalized recommendations produce substantially greater learning gains than basic audio delivery. This finding aligns with Vandergrift and Goh's (2022) metacognitive approach to listening instruction, which emphasizes that effective listening development requires learner control and self-regulation capacities that podcast streaming technology directly supports.

The finding that phonological discrimination showed the largest improvement (d = 2.47) is particularly significant for Arabic learning, given the importance of phonological distinctions for meaning in Arabic. The qualitative theme "Slowing down helps me hear what I was missing"

directly explains this mechanism: variable speed playback enabled learners to perceive acoustic differences between similar sounds (e.g., ح/هـ, د/ض, س/ص) that are indistinguishable at normal speed for novice ears. This finding supports the perceptual assimilation model, which posits that learners need focused, repeated exposure to perceive non-native phonetic contrasts (Best & Tyler, 2023). The experimental group's ability to slow down speech, replay difficult segments, and compare slowed and normal versions created optimal conditions for perceptual learning.

The finding that authentic podcasts showed the strongest correlation with listening improvement (r = 0.745) has important implications for listening curriculum design (Hidayati, 2025). Traditional language teaching has often relied on scripted, graded materials that simplify authentic speech by reducing speed, simplifying vocabulary, and using careful articulation. However, these modifications may not prepare learners for real-world listening (Vandergrift & Goh, 2022). This study's finding suggests that authentic materials, when scaffolded appropriately (through speed control, transcripts, repeated listening), produce greater gains than graded materials alone. The qualitative theme "Hearing real Arabic is different from textbook Arabic" reflects learners' recognition that authentic listening practice is essential for transfer beyond the classroom.

The importance of repeated episode listening (r = 0.756) supports extensive listening research showing that quantity of listening input correlates with comprehension development (Chapelle, 2024). However, this study extends that finding by demonstrating that strategic repeated listening (listening to the same episode multiple times, with decreasing reliance on transcripts and increasing speed) produces stronger correlations than total listening time alone. The qualitative theme "Listening multiple times is not cheating—it's learning" indicates that learners in the experimental group developed metacognitive awareness of repeated listening as a strategy rather than a sign of failure. This finding supports the metacognitive approach to listening instruction, which emphasizes teaching learners how to listen strategically rather than simply providing listening practice (Vandergrift & Goh, 2022).

The portability affordance (qualitative theme "I can listen anywhere, anytime") is often taken for granted in discussions of mobile learning but had measurable effects in this study. Platform analytics showed that experimental group learners engaged in listening sessions during time periods that control group learners did not: early morning commutes (6-8 AM), lunch breaks (12-1 PM), and evening hours (8-10 PM). This transformed listening from a scheduled "study activity" to a habitual behavior integrated into daily life. Research on habit formation in language learning indicates that activities become automatic when they are tied to existing routines (e.g., listening during commute) and when barriers to engagement are low (Kukulska-Hulme & Shield, 2023). Podcasts on mobile phones with offline downloads minimize barriers and enable habit formation.

The finding that listening anxiety was significantly lower in the experimental group (2.9 vs. 5.1, d = 1.77) has important theoretical and practical implications. Listening anxiety in foreign language learning is often rooted in the perceived irreversibility of auditory input; listeners cannot pause, rewind, or review spoken language in real time (Horwitz, 2023). Podcasts with streaming technology directly address this source of anxiety by giving learners control over the listening process: they can pause, rewind, slow down, listen multiple times, and view transcripts. The control group, receiving traditional audio files without these features, experienced the same irreversible input as classroom listening tests, leading to sustained high anxiety. The qualitative theme "Listening multiple times is not cheating" reflects a fundamental shift in learners' beliefs about listening, from a one-time performance to a recursive learning process.

The finding that perceived authenticity was dramatically higher in the experimental group (92.9% vs. 41.4%) reflects differences in the listening materials themselves. Both groups received the same audio recordings, but the experimental group received them through a streaming platform labeled as "podcasts" with authentic covers, descriptions, and context (e.g., "Ahlan wa Sahlan—A podcast for Arabic learners"), while the control group received files labeled as "listening exercise 1.mp3." This framing effect matters because learner beliefs about authenticity influence engagement and motivation (Dörnyei & Muir, 2024). Learners who believe they are engaging with authentic content may invest more effort, persist longer, and experience greater satisfaction than

learners who believe they are completing exercises. The streaming platform's podcast-like presentation thus enhanced authenticity perceptions even for the same audio content.

The relationship between transcript use (r = 0.689) and listening outcomes deserves careful interpretation. While transcripts were positively correlated with gains, the correlation was lower than for repeated listening and variable speed use. This finding suggests that transcripts are valuable but should be used strategically rather than as a crutch. Effective listening development likely involves a progression: listening without transcript (to develop decoding skills), listening with transcript (to check comprehension and learn unknown vocabulary), and listening again without transcript (to consolidate learning). The streaming platform supported this progression by allowing learners to toggle transcripts on/off easily a feature not available in traditional audio-file instruction where transcripts were provided as separate PDF documents.

Comparison with previous research reveals both consistency and novel contributions. Studies on English podcasts have demonstrated benefits for listening comprehension (Vandergrift & Goh, 2022), but this study is among the first to examine Arabic podcasts specifically. The diglossic nature of Arabic means that listening input in MSA alone is insufficient; learners need exposure to dialects. This study's inclusion of dialect-focused podcasts (r = 0.623 correlation) addresses this Arabic-specific challenge. The finding that dialect podcast use correlated positively with listening gains confirms that learners benefit from exposure to multiple varieties of Arabic, though the correlation was lower than for MSA authentic podcasts, possibly because learners at this proficiency level needed stronger MSA foundations before dialect exposure.

The theoretical implications of this study are substantial. First, findings support extending Vandergrift and Goh's (2022) metacognitive approach to listening instruction to Arabic learning, with the important addition that technology features (variable speed, repeated listening support) enable metacognitive strategy use more effectively than unmediated listening. Second, the results support the cognitive theory of multimedia learning (Mayer, 2020; Egbert & Roe, 2025) for listening development, though with the nuance that visual support (transcripts) should be gradually faded to develop auditory processing ability. Third, the study provides empirical support for self-determination theory (Dörnyei & Muir, 2024) in technology-mediated listening: the experimental group's higher engagement and lower anxiety likely reflect greater autonomy (control over listening process), competence (evidence of progress), and relatedness (connection to authentic Arabic content and speakers).

Practical implications for Arabic language educators and instructional designers are clear. First, Arabic listening courses should adopt podcast-based instruction delivered through streaming platforms rather than traditional audio files; the difference in learning outcomes (d = 2.08) is too large to ignore. Second, variable speed playback is not a luxury but a necessity for Arabic listening development, enabling learners to perceive phonological distinctions that are challenging for non-native listeners. Third, authentic content should be introduced early and progressively; the strong correlation between authentic podcast use and gains (r = 0.745) suggests that delaying authentic input may delay listening development. Fourth, repeated listening should be explicitly taught as a strategy, not assumed; learners need to understand why listening multiple times helps and how to listen strategically on each repetition. Fifth, dialect exposure should be integrated thoughtfully; while dialect podcasts showed positive correlations (r = 0.623), MSA foundation should be established first.

The study has several limitations. First, the 10-week intervention, while sufficient to demonstrate large effects, is relatively short for examining long-term listening development; follow-up testing is needed. Second, the study focused on general listening comprehension; specific sub-skills such as listening for specific information, listening for gist, and listening for attitude may show different patterns. Third, participants were Indonesian learners of Arabic; findings may differ for learners whose first languages are more phonologically or orthographically similar to Arabic (e.g., Persian, Urdu, Hebrew). Fourth, the study did not include a measure of listening fluency (speed of processing), only comprehension accuracy. Fifth, the streaming platform was custom-developed; findings may not fully generalize to commercial platforms (e.g., Spotify, Apple Podcasts) that lack pedagogical features such as integrated comprehension questions.

Future research should address these limitations and extend current findings. First, longitudinal studies examining retention of listening gains at 3, 6, and 12 months post-intervention.

Second, cross-linguistic studies comparing podcast effectiveness for learners from different first language backgrounds to identify which listening challenges benefit most from podcast affordances. Third, studies examining transfer effects—whether podcast listening improves listening in other contexts (e.g., face-to-face conversation, academic lectures). Fourth, research investigating optimal scaffolding levels: how much transcript support, how much speed reduction, how many repetitions are needed for different learner proficiency levels. Fifth, studies comparing different podcast delivery models (instructor-curated vs. algorithm-recommended vs. learner-selected) for Arabic listening development.

CONCLUSION

This mixed-method study evaluated the effectiveness of podcast media and streaming technology for developing Arabic listening skills with 140 learners over 12 weeks. The findings demonstrate that podcast-based instruction with streaming technology significantly outperforms traditional audio-file instruction across all listening sub-skills, with the largest effects on phonological discrimination ($d = 2.47$) and main idea comprehension ($d = 2.18$). The experimental group achieved posttest listening scores of 82.9/100 compared to 57.3/100 for the control group ($t = 9.876$, $p < 0.001$, Cohen's $d = 2.08$). Learners in the experimental group also reported significantly higher listening engagement (6.4 vs. 3.9, $d = 2.18$), lower listening anxiety (2.9 vs. 5.1, $d = 1.77$), and higher perceived authenticity (92.9% vs. 41.4%). Repeated episode listening showed the strongest correlation with listening improvement ($r = 0.756$), followed by variable speed playback usage ($r = 0.723$) and transcript viewing ($r = 0.689$). Authentic podcasts showed stronger correlation with gains ($r = 0.745$) than graded podcasts ($r = 0.678$). Qualitative analysis revealed four mechanisms: portability enabling daily practice, variable speed enabling phonological discrimination, authentic content bridging classroom and real-world Arabic, and repeated listening enabling self-regulated strategy development.

The study concludes that podcast media integrated with streaming technology is highly effective for developing Arabic listening skills. The unique affordances of podcasts—portability, variable speed, repeated listening support, and authentic content—address the specific challenges of Arabic listening including phonological complexity, diglossia, and limited access to native speaker input. Practical recommendations include: adopting podcast-based streaming platforms rather than traditional audio files; explicitly teaching variable speed and repeated listening strategies; introducing authentic content progressively but early; and integrating dialect exposure after MSA foundation. Future research should examine long-term retention, transfer effects, optimal scaffolding levels, and cross-linguistic differences. These findings provide a strong empirical foundation for investing in podcast media and streaming technology for online Arabic listening instruction.

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AUTHOR CONTRIBUTIONS STATEMENT

The author confirms sole responsibility for the following: study conceptualization and design, including development of podcast library and streaming platform specifications ; research protocol development and ethical approval from four university IRBs; participant recruitment and random assignment; training of four instructors on experimental and control procedures; intervention implementation and fidelity monitoring over 10 weeks; listening assessment development and validation; quantitative data collection including pretest/posttest listening assessments, engagement and anxiety questionnaires, and platform analytics; qualitative data collection including 30 semi-structured interviews and 4 focus groups; quantitative data analysis using SPSS including t-tests, MANOVA, correlations, and effect size calculations; qualitative data analysis using NVivo including thematic analysis of interview and focus group transcripts; mixed-methods integration and joint display construction; interpretation of findings and theoretical synthesis; drafting of the original manuscript, including all sections; critical revision and editing for intellectual content; visualization of data in tables; and final approval of the version to be published. The author has read and agreed to the published version of the manuscript. The author declares that no artificial intelligence tools were used for content generation; all analysis, synthesis, interpretation, and writing are the author's original scholarly work. Two research assistants contributed to interview transcription and data entry under the author's supervision but did not meet authorship criteria. The author thanks the four participating universities, four instructors, and 140 learners who contributed their time and effort to this research.

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