

# Listening Evaluation API Documentation

## Overview

This document provides comprehensive documentation for the **Listening Evaluation System**. The API supports skill-based evaluation, audio tracking, time duration monitoring, and mastery level calculation for listening comprehension tasks across Day 1 to Day 90.

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## Listening Session APIs

### 1. Start Listening Session

**Endpoint:** `POST /api/v1/listening/sessions`

**Description:** Creates a new listening test session for a specific day with optional audio URL.

**Request Body:**

```
{
  "user_id": "uuid",
  "day_code": "day1",
  "audio_url": "https://example.com/audio/day1-listening.mp3",
  "started_at": "2025-10-06T10:00:00Z"
}
```

**Response:** `201 Created`

```
{
  "session_id": "uuid",
  "user_id": "uuid",
  "modality": "listening",
  "day_code": "day1",
  "audio_url": "https://example.com/audio/day1-listening.mp3",
  "started_at": "2025-10-06T10:00:00Z",
}
```

```
"message": "Listening session started successfully"
}
```

---

## 2. Submit Listening Session

**Endpoint:** `POST /api/v1/listening/sessions/{session_id}/submit`

**Description:** Submit completed listening session with all answers. Each answer includes listening-specific fields like question type, audio timestamps, and skill evaluation.

### Request Body:

```
{
  "answers": [
    {
      "item_id": "q1",
      "question_type": "multiple_choice",
      "user_answer": "B",
      "correct_answer": "B",
      "is_correct": true,
      "time_spent_sec": 45,
      "skill": "main_idea",
      "audio_timestamp_start": 0,
      "audio_timestamp_end": 30,
      "topic": "lecture_economics"
    },
    {
      "item_id": "q2",
      "question_type": "fill_blank",
      "user_answer": "economic growth",
      "correct_answer": "economic growth",
      "is_correct": true,
      "time_spent_sec": 60,
      "skill": "vocabulary",
      "audio_timestamp_start": 15,
      "audio_timestamp_end": 25,
      "topic": "lecture_economics"
    },
    {
      "item_id": "q3",
      "question_type": "true_false",
      "user_answer": "true",
      "correct_answer": "false",
      "is_correct": false,
      "time_spent_sec": 30,
      "skill": "details",
      "audio_timestamp_start": 50,
      "audio_timestamp_end": 75,
      "topic": "lecture_economics"
    }
  ]
}
```

```
],  
"completed_at": "2025-10-06T10:15:00Z",  
"duration_sec": 900,  
"score_pct": 67,  
"xp_earned": 80,  
"audio_replay_count": 2  
}
```

**Response:** 200 OK

```
{  
  "session_id": "uuid",  
  "analytics_recorded": true,  
  "xp_awarded": 80,  
  "badges_awarded": [  
    {  
      "badge_key": "listening_streak_5",  
      "title": "5-Day Listening Streak",  
      "earned_at": "2025-10-06T10:15:00Z"  
    }  
  ],  
  "streak_updated": true,  
  "current_streak": 5,  
  "skill_mastery_recorded": true,  
  "message": "Listening session submitted successfully"  
}
```

---

### 3. Get Listening Session Details

**Endpoint:** GET /api/v1/listening/sessions/{session\_id}

**Description:** Retrieve complete listening session information including all answers and metadata.

**Response:** 200 OK

```
{  
  "session_id": "uuid",  
  "user_id": "uuid",  
  "modality": "listening",  
  "day_code": "day1",  
  "audio_url": "https://example.com/audio/day1-listening.mp3",  
  "started_at": "2025-10-06T10:00:00Z",  
  "completed_at": "2025-10-06T10:15:00Z",  
  "duration_sec": 900,  
  "score_pct": 67,  
  "xp_earned": 80,  
  "audio_replay_count": 2,  
  "answers": [  

```

```
{
  "answer_id": "uuid",
  "item_id": "q1",
  "question_type": "multiple_choice",
  "user_answer": "B",
  "correct_answer": "B",
  "is_correct": true,
  "time_spent_sec": 45,
  "skill": "main_idea",
  "audio_timestamp_start": 0,
  "audio_timestamp_end": 30,
  "topic": "lecture_economics"
}
```

---

## Listening Mastery & Analytics APIs

### 4. Get Listening Session Mastery

**Endpoint:** `GET /api/v1/listening/sessions/{session_id}/mastery`

**Description:** Returns skill-by-skill mastery breakdown for a completed listening session.

**Response:** `200 OK`

```
{
  "session_id": "uuid",
  "modality": "listening",
  "day_code": "day1",
  "overall_score_pct": 67,
  "duration_sec": 900,
  "audio_replay_count": 2,
  "skills": [
    {
      "skill": "main_idea",
      "correct": 8,
      "total": 10,
      "mastery_pct": 80,
      "mastery_level": "proficient"
    },
    {
      "skill": "vocabulary",
      "correct": 5,
      "total": 6,
      "mastery_pct": 83,
      "mastery_level": "proficient"
    },
    {
      "skill": "details",

```

```
    "correct": 3,
    "total": 5,
    "mastery_pct": 60,
    "mastery_level": "developing"
  },
  {
    "skill": "inference",
    "correct": 4,
    "total": 6,
    "mastery_pct": 67,
    "mastery_level": "developing"
  }
],
"mastery_levels": {
  "beginner": 0,
  "developing": 2,
  "proficient": 2,
  "advanced": 0
}
}
```

---

## 5. Get User Listening Progress

**Endpoint:** `GET /api/v1/listening/users/{user_id}/progress`

**Description:** Track user's listening skill development across sessions with detailed statistics.

**Query Parameters:**

- `from_day` (optional): Starting day code (e.g., `day1`)
- `to_day` (optional): Ending day code (e.g., `day10`)

**Example:** `GET /api/v1/listening/users/{user_id}/progress?  
from_day=day1&to_day=day10`

**Response:** `200 OK`

```
{
  "modality": "listening",
  "date_range": "day1-day10",
  "overall_mastery_pct": 75,
  "total_sessions": 10,
  "total_audio_replay_count": 18,
  "skills": [
    {
      "skill": "vocabulary",
      "sessions_practiced": 10,
      "total_questions": 60,
      "correct_answers": 52,
      "overall_mastery_pct": 87,
      "mastery_level": "proficient",

```

```
    "trend": "improving",
    "avg_time_per_question": 42.5
  },
  {
    "skill": "main_idea",
    "sessions_practiced": 10,
    "total_questions": 80,
    "correct_answers": 64,
    "overall_mastery_pct": 80,
    "mastery_level": "proficient",
    "trend": "stable",
    "avg_time_per_question": 55.2
  },
  {
    "skill": "details",
    "sessions_practiced": 9,
    "total_questions": 45,
    "correct_answers": 30,
    "overall_mastery_pct": 67,
    "mastery_level": "developing",
    "trend": "improving",
    "avg_time_per_question": 38.7
  },
  {
    "skill": "inference",
    "sessions_practiced": 8,
    "total_questions": 40,
    "correct_answers": 32,
    "overall_mastery_pct": 80,
    "mastery_level": "proficient",
    "trend": "stable",
    "avg_time_per_question": 65.3
  },
  {
    "skill": "speaker_purpose",
    "sessions_practiced": 7,
    "total_questions": 28,
    "correct_answers": 19,
    "overall_mastery_pct": 68,
    "mastery_level": "developing",
    "trend": "improving",
    "avg_time_per_question": 48.1
  }
]
```

---

## 6. Get Listening Analytics

**Endpoint:** `GET /api/v1/listening/users/{user_id}/analytics`

**Description:** Comprehensive listening analytics including improvement rate and skill comparison.

Response: 200 OK

```
{
  "user_id": "uuid",
  "total_sessions": 25,
  "avg_score_pct": 78.5,
  "total_duration_sec": 22500,
  "total_audio_replays": 45,
  "strongest_skill": "vocabulary",
  "weakest_skill": "speaker_purpose",
  "improvement_rate": 15.3
}
```

## Data Models

### ListeningAnswerSubmission

```
{
  "item_id": "string",
  "question_type": "multiple_choice | fill_blank | true_false |
short_answer | matching",
  "user_answer": "string | null",
  "correct_answer": "string",
  "is_correct": "boolean",
  "time_spent_sec": "integer (≥0)",
  "skill": "vocabulary | main_idea | details | inference | speaker_purpose
| tone | organization | connecting_ideas",
  "audio_timestamp_start": "integer | null (seconds)",
  "audio_timestamp_end": "integer | null (seconds)",
  "topic": "string | null"
}
```

### Question Types

Type	Description	Example
multiple_choice	Select from options A-D	"What is the main idea?"
fill_blank	Complete missing word/phrase	"The economy grew by ____%"
true_false	Binary true/false question	"The speaker supports the policy. T/F"
short_answer	Brief written response	"Why did the speaker mention...?"
matching	Match items from two lists	"Match speakers to their views"

## Listening Skills Taxonomy

## Core Listening Skills

Skill	Description	Example Question
vocabulary	Word recognition and meaning in audio context	"What does 'fluctuate' mean as used?"
main_idea	Understanding the central message or topic	"What is the lecture mainly about?"
details	Specific information recall from audio	"How many participants were in the study?"
inference	Drawing conclusions from what's heard	"What can be inferred about the speaker's opinion?"
speaker_purpose	Understanding why the speaker said something	"Why does the professor mention dolphins?"
tone	Recognizing attitude, emotion, or certainty	"What is the speaker's attitude toward...?"
organization	Understanding how ideas are structured	"How does the speaker organize the information?"
connecting_ideas	Linking related concepts across the audio	"How does this example relate to the main point?"

## Listening-Specific Features

### 1. Audio Timestamp Tracking

Track which part of the audio each question relates to:

```
{
  "audio_timestamp_start": 45,
  "audio_timestamp_end": 75
}
```

Use Cases:

- Review specific audio segments for incorrect answers
- Analyze which audio sections are most challenging
- Enable targeted practice for weak segments

### 2. Audio Replay Count

Track how many times users replay audio during the session:



```
{
  "audio_replay_count": 2
}
```

**Insights:**

- High replay counts may indicate audio difficulty
  - Track if replays correlate with better scores
  - Identify users who may need slower-paced audio
- 

### 3. Question Type Analysis

Each answer includes `question_type` for granular analysis:

```
{
  "question_type": "multiple_choice"
}
```

**Benefits:**

- Identify which question formats are most challenging
  - Balance question types in content creation
  - Tailor practice based on weak question types
- 

### 4. Time Per Question Analytics

The system automatically calculates average time spent per skill:

```
{
  "skill": "inference",
  "avg_time_per_question": 65.3
}
```

**Insights:**

- Inference questions take longer on average
  - Vocabulary questions are answered more quickly
  - Track speed improvements over time
- 

## Usage Examples

Example 1: Complete Listening Session Flow (Day 3)

**Step 1: Start Session**

```
POST /api/v1/listening/sessions
```

```
{
  "user_id": "abc-123-def",
  "day_code": "day3",
  "audio_url": "https://cdn.example.com/listening/day3-conversation.mp3",
  "started_at": "2025-10-06T14:00:00Z"
}
```

**Response:**

```
{
  "session_id": "xyz-789",
  "user_id": "abc-123-def",
  "modality": "listening",
  "day_code": "day3",
  "audio_url": "https://cdn.example.com/listening/day3-conversation.mp3",
  "started_at": "2025-10-06T14:00:00Z"
}
```

---

**Step 2: User Completes Questions, Submit Session**

```
POST /api/v1/listening/sessions/xyz-789/submit
```

```
{
  "answers": [
    {
      "item_id": "day3_q1",
      "question_type": "multiple_choice",
      "user_answer": "A",
      "correct_answer": "A",
      "is_correct": true,
      "time_spent_sec": 40,
      "skill": "main_idea",
      "audio_timestamp_start": 0,
      "audio_timestamp_end": 60,
      "topic": "campus_conversation"
    },
    {
      "item_id": "day3_q2",
      "question_type": "fill_blank",
      "user_answer": "library",
      "correct_answer": "library",
      "is_correct": true,
      "time_spent_sec": 35,
      "skill": "details",
      "audio_timestamp_start": 20,

```

```
    "audio_timestamp_end": 30,
    "topic": "campus_conversation"
  },
  {
    "item_id": "day3_q3",
    "question_type": "true_false",
    "user_answer": "true",
    "correct_answer": "false",
    "is_correct": false,
    "time_spent_sec": 25,
    "skill": "inference",
    "audio_timestamp_start": 45,
    "audio_timestamp_end": 60,
    "topic": "campus_conversation"
  }
],
"completed_at": "2025-10-06T14:12:00Z",
"duration_sec": 720,
"score_pct": 67,
"xp_earned": 75,
"audio_replay_count": 1
}
```

---

### Step 3: Check Mastery Breakdown

```
GET /api/v1/listening/sessions/xyz-789/mastery
```

#### Response:

```
{
  "session_id": "xyz-789",
  "modality": "listening",
  "day_code": "day3",
  "overall_score_pct": 67,
  "duration_sec": 720,
  "audio_replay_count": 1,
  "skills": [
    {
      "skill": "main_idea",
      "correct": 1,
      "total": 1,
      "mastery_pct": 100,
      "mastery_level": "advanced"
    },
    {
      "skill": "details",
      "correct": 1,
      "total": 1,

```

```
    "mastery_pct": 100,
    "mastery_level": "advanced"
  },
  {
    "skill": "inference",
    "correct": 0,
    "total": 1,
    "mastery_pct": 0,
    "mastery_level": "beginner"
  }
],
"mastery_levels": {
  "beginner": 1,
  "developing": 0,
  "proficient": 0,
  "advanced": 2
}
}
```

---

## Example 2: Track Progress After 10 Days

### Request:

```
GET /api/v1/listening/users/abc-123-def/progress?
from_day=day1&to_day=day10
```

### Response:

```
{
  "modality": "listening",
  "date_range": "day1-day10",
  "overall_mastery_pct": 78,
  "total_sessions": 10,
  "total_audio_replay_count": 15,
  "skills": [
    {
      "skill": "vocabulary",
      "sessions_practiced": 10,
      "total_questions": 50,
      "correct_answers": 43,
      "overall_mastery_pct": 86,
      "mastery_level": "proficient",
      "trend": "improving",
      "avg_time_per_question": 38.2
    },
    {
      "skill": "inference",
      "sessions_practiced": 10,
```

```
    "total_questions": 40,  
    "correct_answers": 28,  
    "overall_mastery_pct": 70,  
    "mastery_level": "developing",  
    "trend": "stable",  
    "avg_time_per_question": 62.5  
  }  
]  
}
```

---

### Example 3: View Listening Analytics Dashboard

#### Request:

```
GET /api/v1/listening/users/abc-123-def/analytics
```

#### Response:

```
{  
  "user_id": "abc-123-def",  
  "total_sessions": 30,  
  "avg_score_pct": 82.3,  
  "total_duration_sec": 27000,  
  "total_audio_replays": 42,  
  "strongest_skill": "vocabulary",  
  "weakest_skill": "speaker_purpose",  
  "improvement_rate": 18.7  
}
```

#### Insights:

- User has improved 18.7% from first to latest session
- Vocabulary is strongest (likely 90%+ mastery)
- Speaker purpose needs work (likely <65% mastery)
- Average 42 audio replays across 30 sessions = 1.4 replays per session

---

## Best Practices

### Frontend Implementation

#### 1. Audio Player Integration

```
// Track audio replays  
let audioReplayCount = 0;
```

```
audioPlayer.addEventListener('ended', () => {  
  if (userReplaysAudio) {  
    audioReplayCount++;  
  }  
});
```

## 2. Time Tracking Per Question

```
// Start timer when question is displayed  
const questionStartTime = Date.now();  
  
// Calculate time spent when answer submitted  
const timeSpent = Math.floor((Date.now() - questionStartTime) / 1000);  
  
answerData.time_spent_sec = timeSpent;
```

## 3. Audio Timestamp Association

```
// Link question to specific audio segment  
const questionData = {  
  item_id: "q5",  
  audio_timestamp_start: 120, // 2:00 in audio  
  audio_timestamp_end: 150 // 2:30 in audio  
};  
  
// Allow user to replay specific segment for review  
function replayQuestionAudio(question) {  
  audioPlayer.currentTime = question.audio_timestamp_start;  
  audioPlayer.play();  
}
```

---

## Content Creation Guidelines

### 1. Question Distribution by Skill

Recommended distribution per session:

- **Vocabulary:** 20-25%
- **Main Idea:** 15-20%
- **Details:** 25-30%
- **Inference:** 15-20%
- **Speaker Purpose:** 10-15%
- **Other Skills:** 5-10%

## 2. Question Type Variety

Mix question types for engagement:

- Multiple Choice: 40-50%
- Fill in the Blank: 20-25%
- True/False: 15-20%
- Short Answer: 10-15%

## 3. Audio Length Guidelines

- **Day 1-30:** 2-3 minute audio clips
- **Day 31-60:** 3-5 minute audio clips
- **Day 61-90:** 5-7 minute audio clips

---

## Performance Optimization

1. **Lazy Load Audio:** Only load audio when session starts
  2. **Cache Audio Files:** Use CDN with long cache times
  3. **Batch Answer Submission:** Submit all answers at once
  4. **Async Analytics:** Process skill mastery calculations asynchronously
- 

## Error Handling

### Common Errors

**400 Bad Request** - Invalid question type:

```
{
  "detail": "question_type must be one of: multiple_choice, fill_blank,
true_false, short_answer, matching"
}
```

**404 Not Found** - Session doesn't exist:

```
{
  "detail": "Listening session not found"
}
```

**403 Forbidden** - Unauthorized access:

```
{
  "detail": "Cannot submit another user's session"
}
```

---

## 422 Validation Error - Missing skill field:

```
{
  "detail": [
    {
      "loc": ["body", "answers", 0, "skill"],
      "msg": "field required",
      "type": "value_error.missing"
    }
  ]
}
```

---

## Integration Checklist

- ☐ Audio player with replay tracking implemented
- ☐ Time tracking per question active
- ☐ Audio timestamp association configured
- ☐ All 8 listening skills mapped to content
- ☐ Question types properly categorized
- ☐ Audio URLs configured and tested
- ☐ Progress dashboard displays listening-specific data
- ☐ Audio replay analytics visible to instructors
- ☐ Review functionality allows segment replay

---

## Database Schema

The listening system uses the same core tables with modality-specific data:

### Listening Sessions

Stored in `lrg_sessions` with `modality = 'listening'`

### Listening Answers

Stored in `lrg_answers` with listening-specific fields:

- `skill`: One of 8 listening skills
- `time_spent_sec`: Duration per question
- `topic`: Audio passage identifier

### Listening Skill Mastery

Stored in `lrg_skill_mastery` with `modality = 'listening'`

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## Support & Feedback



For API questions or feature requests:

- **API Documentation:** [/docs](#) (Swagger UI)
  - **ReDoc:** [/redoc](#)
  - **Code:** Check [app/services/listening\\_service.py](#) and [app/api/v1/listening.py](#)
- 

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