A APPENDIX

A.1 USE OF LARGE LANGUAGE MODELS

Large Language Models (LLMs) utilized in this work are as follows:(1) *Topics Initiation* during data processing of the Real-Pod dataset, which is elaborated in Section 3. (2) *LLM-as-a-Judge* method in text-based evaluation, which is illustrated in Section 4. (3) *Summarized Users' Justifications* in the Questionnaire-based MOS Test, which is described in Section 7.3 (Questionnaire-based MOS Test).

A.2 TEXT-BASED EVALUATION

A.2.1 QUANTITATIVE METRICS

Table 4: **GPT-4**: Quantitative metrics in text-based evaluation.

Metrics	**Overall**	**Fiction**	**Education**	**Business**	**True Crime**	**Health & Fitness**
Distinct_2	0.9619	0.9643	0.9588	0.9567	0.9689	0.9638
Info-Dens	6.4507	6.5865	6.4569	6.3213	6.6541	6.3880
Sem-Div	0.1293	0.1204	0.1115	0.1214	0.1443	0.1106
MATTR	0.6914	0.7027	0.6989	0.6933	0.6831	0.6870
Metrics	**Sports**	**Comedy**	**History**	**News**	**TV & Film**	**Society & Culture**
Distinct_2	0.9536	0.9633	0.9471	0.9486	0.9678	0.9659
Info-Dens	6.4228	6.2256	6.3792	6.3225	6.7614	6.6473
Sem-Div	0.1248	0.1356	0.1451	0.1208	0.1553	0.1507
MATTR	0.6973	0.6922	0.6905	0.6756	0.6903	0.6901
Metrics	**Arts**	**Leisure**	**Music**	**Kids**	**Mental Health**	**Science & Tech**
Distinct_2	0.9675	0.9729	0.9555	0.9559	0.9699	0.9710
Info-Dens	6.5054	6.5233	6.4119	6.2310	6.4787	6.3454
Sem-Div	0.1374	0.1117	0.1320	0.1229	0.1247	0.1286
MATTR	0.6885	0.7136	0.6677	0.6884	0.6994	0.6960

Table 5: **PodAgent**: Quantitative metrics in text-based evaluation.

Metrics	Overall	Fiction	Education	Business	True Crime	Health & Fitness
Distinct_2	0.9741	0.9743	0.9730	0.9758	0.9796	0.9825
Info-Dens	7.1767	7.3791	7.2163	7.1126	7.1810	7.2927
Sem-Div	0.1372	0.1384	0.1210	0.1254	0.1514	0.1171
MATTR	0.7216	0.7399	0.7291	0.7258	0.7263	0.7386
Metrics	**Sports**	**Comedy**	**History**	**News**	**TV & Film**	**Society & Culture**
Distinct_2	0.9678	0.9808	0.9483	0.9735	0.9782	0.9744
Info-Dens	7.1239	7.1600	7.1004	7.1282	7.3311	6.9568
Sem-Div	0.1487	0.1236	0.1543	0.1379	0.1690	0.1344
MATTR	0.7183	0.7248	0.6752	0.7156	0.7274	0.7119
Metrics	**Arts**	**Leisure**	**Music**	**Kids**	**Mental Health**	**Science & Tech**
Distinct_2	0.9701	0.9790	0.9739	0.9747	0.9815	0.9725
Info-Dens	7.1977	7.3227	7.0558	7.0930	7.1822	7.1711
Sem-Div	0.1283	0.1445	0.1440	0.1353	0.1259	0.1331
MATTR	0.7101	0.7275	0.7114	0.7279	0.7328	0.7249

Table 6: **MoonCast**: Quantitative metrics in text-based evaluation.

Metrics	Overall	Fiction	Education	Business	True Crime	Health & Fitness
Distinct_2	0.9128	0.9219	0.8998	0.8952	0.9132	0.9478
Info-Dens	6.0935	6.3613	5.9779	5.9931	6.0388	6.4230
Sem-Div	0.1326	0.1515	0.1079	0.1326	0.1405	0.1324
MATTR	0.6323	0.6598	0.6237	0.6310	0.6391	0.6698
Metrics	**Sports**	**Comedy**	**History**	**News**	**TV & Film**	**Society & Culture**
Distinct_2	0.9159	0.9232	0.9169	0.9047	0.9408	0.8959
Info-Dens	6.1933	6.1729	6.2229	5.9672	6.2855	5.8031
Sem-Div	0.1451	0.1311	0.1460	0.1176	0.1318	0.1282
MATTR	0.6402	0.6435	0.6276	0.6111	0.6595	0.6121
Metrics	**Arts**	**Leisure**	**Music**	**Kids**	**Mental Health**	**Science & Tech**
Distinct_2	0.9252	0.8889	0.8957	0.9039	0.9222	0.9073
Info-Dens	6.2335	5.9713	5.9411	5.9291	6.0298	6.0459
Sem-Div	0.1444	0.1309	0.1227	0.1291	0.1187	0.1432
MATTR	0.6370	0.6124	0.6035	0.6183	0.6321	0.6277

Table 7: **Real-Pod**: Quantitative metrics in text-based evaluation.

Metrics	Overall	Fiction	Education	Business	True Crime	Health & Fitness
Distinct_2	0.9200	0.9292	0.9275	0.9049	0.9169	0.9273
Info-Dens	8.1168	8.2849	8.1160	7.7755	8.5675	7.9301
Sem-Div	0.1677	0.1776	0.1579	0.1433	0.1906	0.1646
MATTR	0.6251	0.6313	0.6346	0.6041	0.6261	0.6380
Metrics	**Sports**	**Comedy**	**History**	**News**	**TV & Film**	**Society & Culture**
Distinct_2	0.9244	0.8994	0.9272	0.9100	0.9201	0.8932
Info-Dens	8.0993	8.2755	8.8282	7.7886	8.4005	7.7375
Sem-Div	0.1919	0.1660	0.1845	0.1618	0.1784	0.1701
MATTR	0.6434	0.5999	0.6304	0.6102	0.6363	0.5823
Metrics	**Arts**	**Leisure**	**Music**	**Kids**	**Mental Health**	**Science & Tech**
Distinct_2	0.9111	0.9242	0.9420	0.9092	0.9298	0.9439
Info-Dens	8.1093	7.6949	8.0925	7.7708	8.2119	8.3031
Sem-Div	0.1653	0.1591	0.1761	0.1492	0.1668	0.1485
MATTR	0.6063	0.6176	0.6513	0.6200	0.6373	0.6582

A.2.2 LLM-AS-A-JUDGE

Table 8: **LLM-as-a-Judge: comparison between GPT-4 and PodAgent.** Scores range from -3 to 3. Positive values indicate that PodAgent outperforms GPT-4; Negative values suggest the opposite.

Metrics	Overall	Fiction	Education	Business	True Crime	Health & Fitness
Coherence	0.7059	0.5000	0.8333	1.0000	1.0000	0.6667
Engagingness	1.0294	1.1667	1.0000	1.1667	0.6667	1.1667
Diversity	1.1765	1.3333	1.0000	1.3333	0.8333	1.5000
Informativeness	1.6078	1.5000	1.6667	2.0000	1.1667	1.6667
Speaker Difference	1.0637	0.9167	1.0000	1.1667	0.6667	1.0000
Overall	1.3064	1.2500	1.3333	1.6667	0.8333	1.2500
Metrics	**Sports**	**Comedy**	**History**	**News**	**TV & Film**	**Society & Culture**
Coherence	0.5000	0.8333	1.1667	0.6667	0.8333	0.1667
Engagingness	1.1667	1.5000	1.5000	0.6667	0.1667	0.6667
Diversity	1.1667	1.8333	1.5000	1.3333	1.3333	0.8333
Informativeness	1.5000	2.1667	1.5000	2.0000	1.3333	0.8333
Speaker Difference	1.1667	1.5000	1.1667	1.3333	1.1667	1.3333
Overall	1.5000	1.8333	1.5000	1.5000	0.8333	0.5000
Metrics	**Arts**	**Leisure**	**Music**	**Kids**	**Mental Health**	**Science & Tech**
Coherence	0.6667	0.5000	0.6667	0.5000	0.3333	1.1667
Engagingness	1.1667	1.1667	1.1667	1.0000	0.8333	1.3333
Diversity	1.1667	1.1667	1.0000	1.0000	0.3333	1.3333
Informativeness	1.8333	2.0000	1.8333	1.3333	1.1667	1.8333
Speaker Difference	1.3333	1.1667	0.8333	0.8333	0.6667	0.8333
Overall	1.5000	1.6667	1.5000	1.1667	0.8333	1.5417

A.3 SPEECH-BASED EVALUATION (SUBJECTIVE)

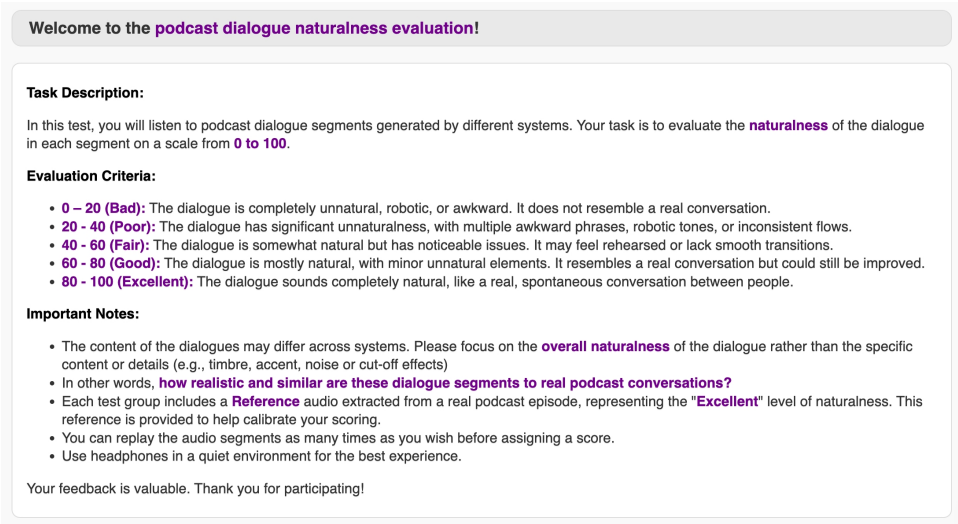


Figure 7: Dialogue Naturalness Evaluation - Instruction page.

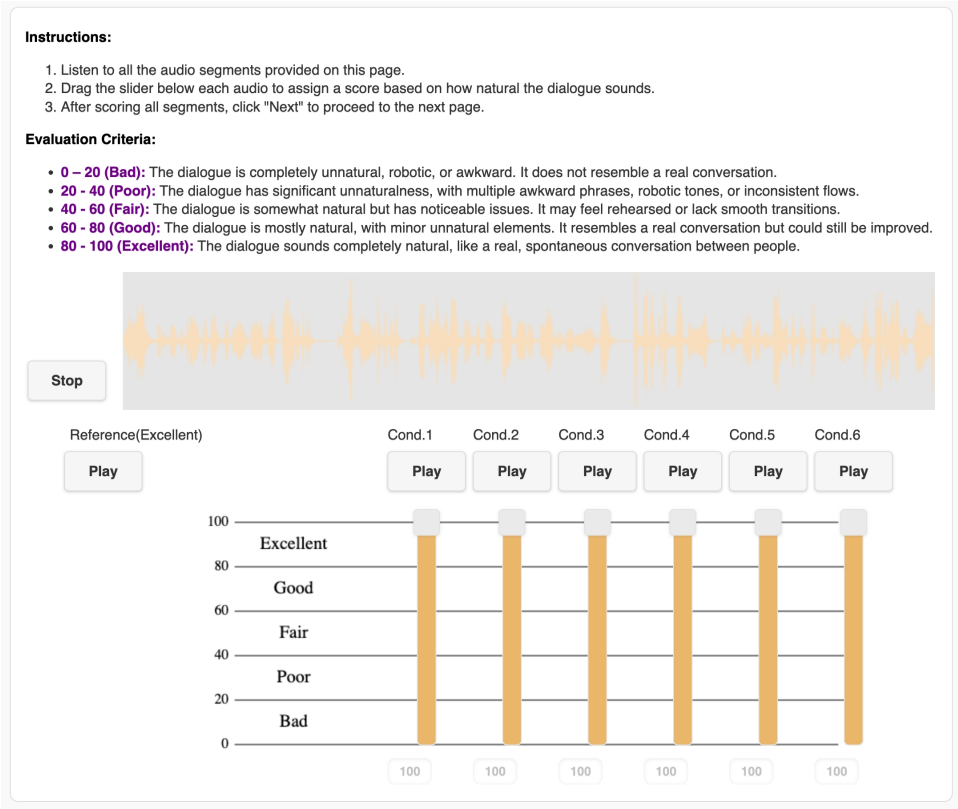


Figure 8: Dialogue Naturalness Evaluation - Test page.

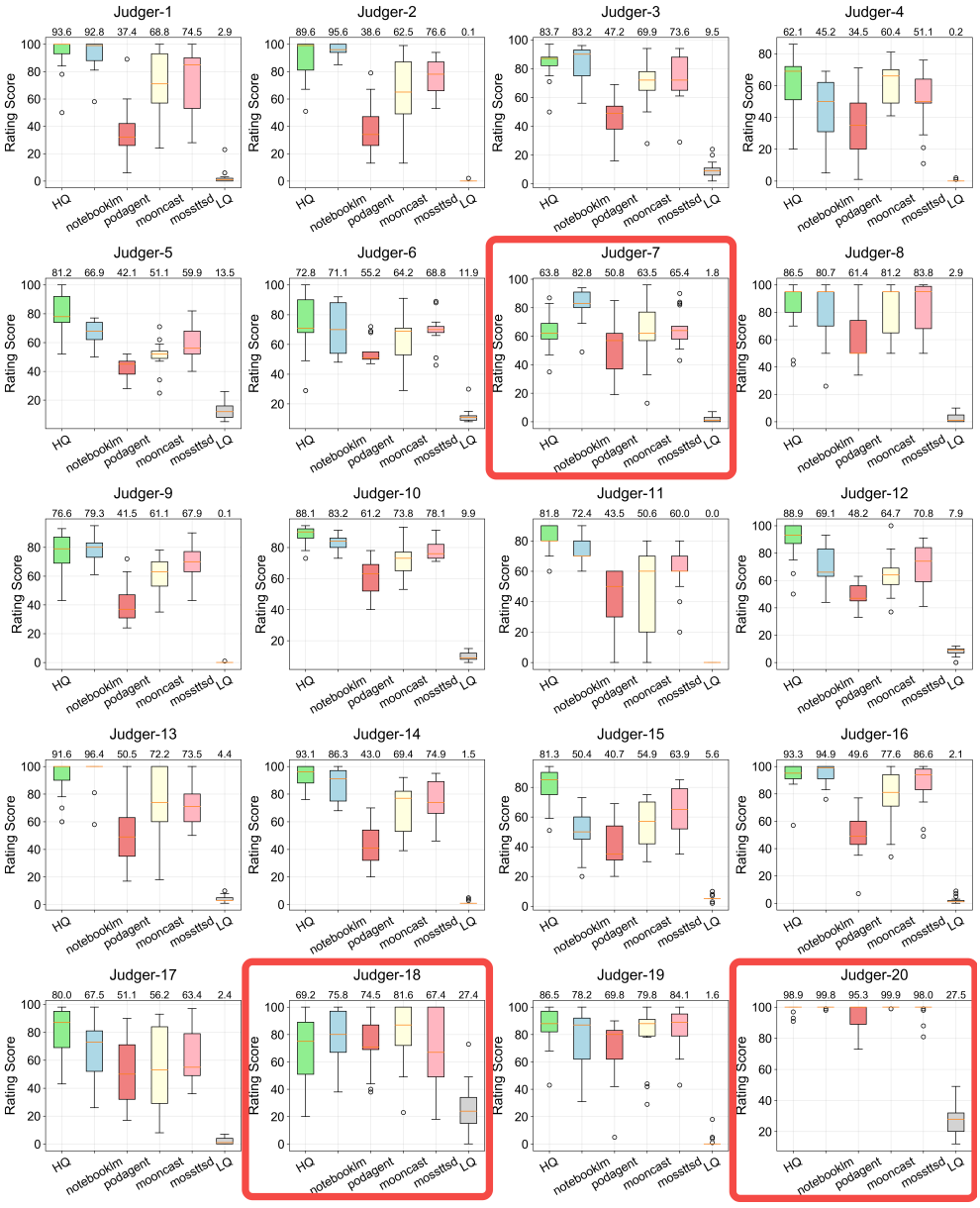


Figure 9: Dialogue Naturalness Evaluation test results from each juders.

A.4 AUDIO-BASED EVALUATION (OBJECTIVE)

IDL: LOUD-IT; TP: LOUD-TP; LRA: LOUD-RA.

$$S_{\text{IDL}} = \begin{cases} 1, & -18 \leq \text{IDL} \leq -14, \\ e^{-k_1 \cdot (-18 - \text{IDL})}, & \text{IDL} < -18, \\ e^{-k_2 \cdot (\text{IDL} + 14)}, & -14 < \text{IDL}, \end{cases} \tag{2}$$

where k_1 is set as 0.0858 to ensure S_{IDL} is around 0.6 when IDL $= -23$, and k_2 is set as 0.3291 to make S_{IDL} close to 0 when IDL $= 0$.

$$S_{\text{TP}} = \begin{cases} 1, & \text{TP} \leq -1 \\ e^{-k_3 \cdot (\text{TP}+1)}, & \text{TP} > -1 \end{cases} \tag{3}$$

where k_3 is set as 4.605 to ensure S_{TP} is close to 0 when TP approaches 0.

$$S_{\text{LRA}} = \begin{cases} 1, & 4 \leq \text{LRA} \leq 18, \\ e^{-k_4 \cdot (4 - \text{LRA})}, & \text{LRA} < 4, \\ e^{-k_5 \cdot (\text{LRA} - 18)}, & \text{LRA} > 18. \end{cases} \tag{4}$$

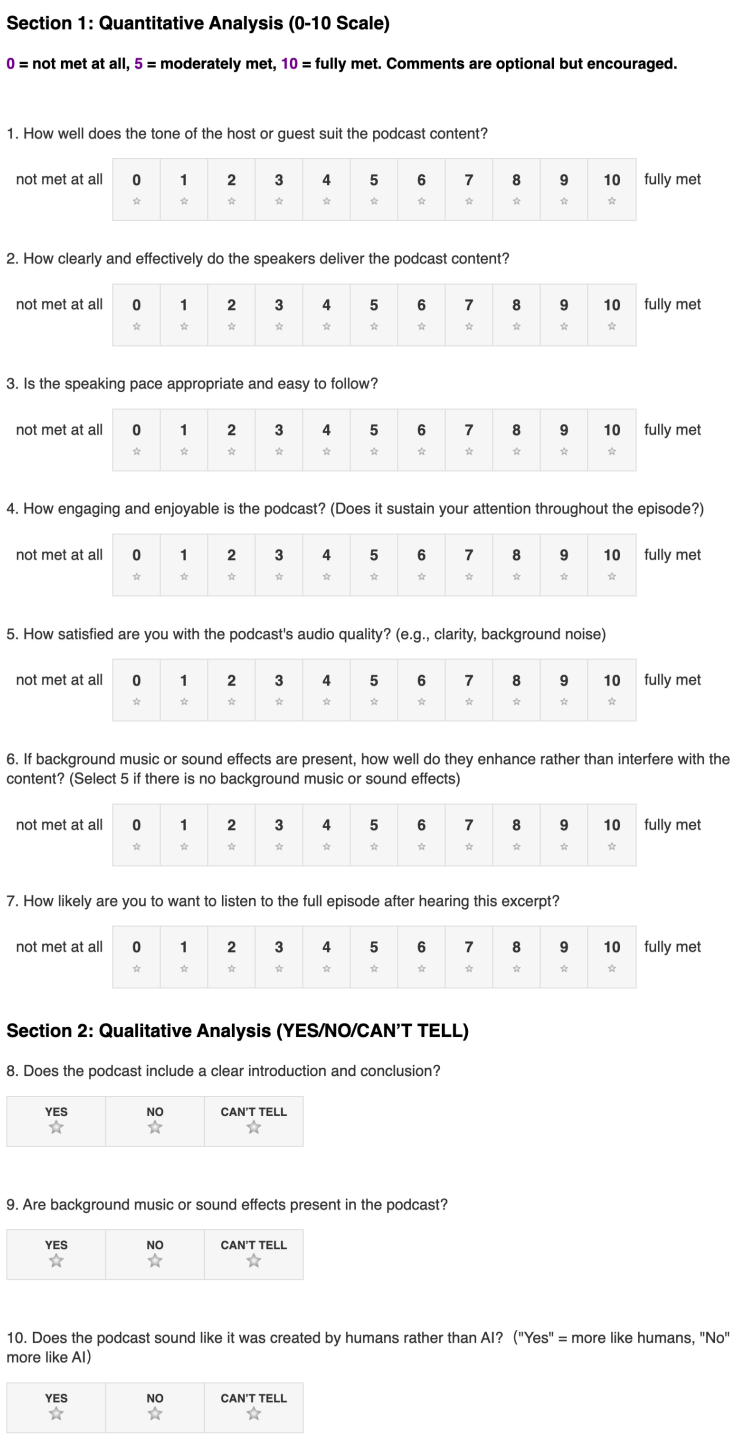
where k_4 is set as 1.1513 to ensure S_{LRA} approaches 0 when LRA $= 0$, and k_5 is set as 0.2554 to ensure $S_{\text{LRA}} \approx 0.6$ when LRA $= 20$.

Table 9: Audio-based objective metrics - Quantitative scores.

System	LOUD_IT_SCORE	LOUD_TP_SCORE	LOUD_LRA_SCORE	SMR_BASIC_SCORE	CASP
Real-Pod	0.72	0.53	0.82	0.99	0.58
PodAgent	0.80	0.32	1.00	1.00	0.56
MoonCast	1.00	0.01	0.68	-	-
Muyan-TTS	0.88	1.00	0.83	-	-
Dia	0.98	0.01	0.95	-	-
MOSS-TTSD	0.88	0.02	0.99	-	-
NotebookLM	0.51	0.56	1.00	-	-

A.5 AUDIO-BASED EVALUATION (SUBJECTIVE)

A.5.1 PILOT TEST



Section 1: Quantitative Analysis (0-10 Scale)

0 = not met at all, 5 = moderately met, 10 = fully met. Comments are optional but encouraged.

1. How well does the tone of the host or guest suit the podcast content?

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

2. How clearly and effectively do the speakers deliver the podcast content?

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

3. Is the speaking pace appropriate and easy to follow?

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

4. How engaging and enjoyable is the podcast? (Does it sustain your attention throughout the episode?)

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

5. How satisfied are you with the podcast's audio quality? (e.g., clarity, background noise)

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

6. If background music or sound effects are present, how well do they enhance rather than interfere with the content? (Select 5 if there is no background music or sound effects)

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

7. How likely are you to want to listen to the full episode after hearing this excerpt?

not met at all | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | fully met

Section 2: Qualitative Analysis (YES/NO/CAN'T TELL)

8. Does the podcast include a clear introduction and conclusion?

YES | NO | CAN'T TELL

9. Are background music or sound effects present in the podcast?

YES | NO | CAN'T TELL

10. Does the podcast sound like it was created by humans rather than AI? ("Yes" = more like humans, "No" more like AI)

YES | NO | CAN'T TELL

Figure 10: Questionnaire-based MOS test - Pilot test version.

A.5.2 QUESTIONNAIRE-BASED MOS TEST

Experiment Settings: Lengthy listening tests can be exhausting and may lead to inaccurate feedback. It is essential to ensure the overall test duration does not exceed 30 minutes. In the Questionnaire-based MOS Test, each audio sample is around 3 minutes and requires answering 10 questions with corresponding justifications. Based on the Dialogue Naturalness Test results shown in Figure 7.2, we selected 4 representative systems. Each test group included four podcast samples from different systems but within the same podcast category. According to actual test results, each group took an average of 24 minutes to complete. The 4 representative systems are:

- **PodAgent:** An open-source podcast generation framework incorporating conversation script generation, automatic voice selection, speech synthesis, and BMSE enhancement.
- **MOSS-TTSD:** Achieved the highest score among the open-source systems utilized in the Dialogue Naturalness Evaluation (Figure 7.2).
- **NotebookLM:** A pioneering podcast generation product, widely recognized for its exceptional performance, is nearly indistinguishable from real podcasts.
- **Real-Pod:** A collection of podcasts sourced from the real world.

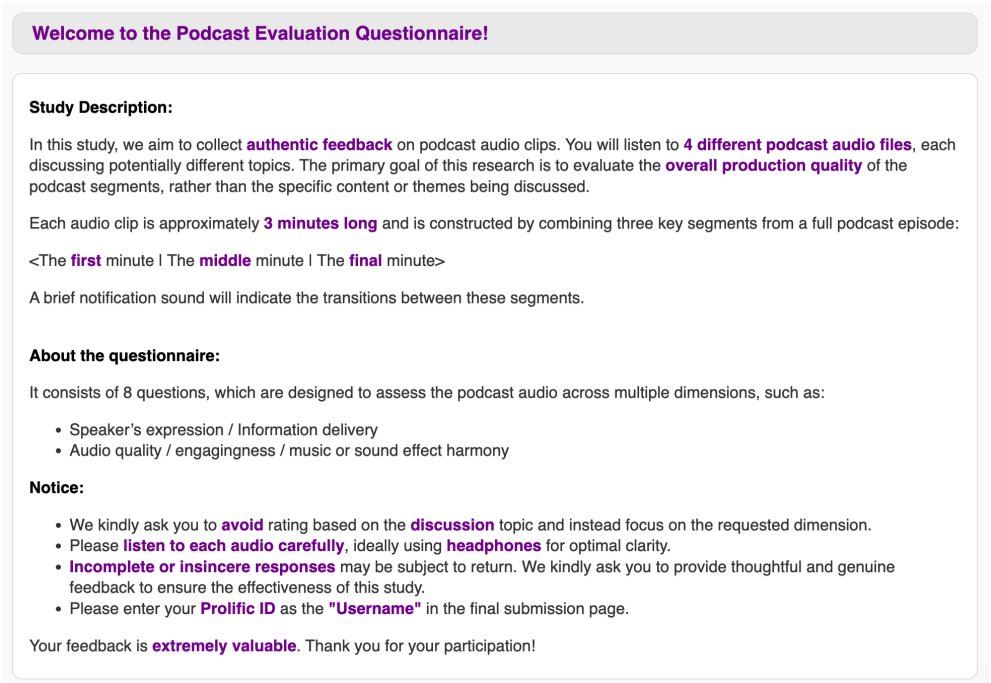


Figure 11: Questionnaire-based MOS test - Final version - Instruction page.

Q1. **How many speakers** are there in the podcast?

Q2. How satisfied are you with the podcast's **audio quality** (e.g., clarity, volume levels, background noise)?

- 1 = Very dissatisfied
- 2 = Dissatisfied
- 3 = Neutral
- 4 = Satisfied
- 5 = Very satisfied

Why? (Required but can be simple. The same requirement for other "Why?" questions.)

Q3. Do you like the way the guests and hosts **express** themselves?

- 1 = Strongly dislike it
- 2 = Dislike it
- 3 = Neutral
- 4 = Like it
- 5 = Love it

Why?

Q4. Do you think the speakers are **effectively** delivering the information?

- 1 = Not at all effectively
- 2 = Not very effectively
- 3 = Neutral
- 4 = Somewhat effectively
- 5 = Very effectively

Why?

Q5. If **music or sound effects** are present, do they **enhance or interfere** with the content? (Select Neutral if none are present)

- 1 = Greatly interfere
- 2 = Somewhat interfere
- 3 = Neutral
- 4 = Somewhat enhance
- 5 = Greatly enhance

Why?

Figure 12: Questionnaire-based MOS test - Final version (Question 1-5).

Q6. How **engaging** is the podcast?

- ◯ 1 = Not engaging at all
- ◯ 2 = Slightly engaging
- ◯ 3 = Neutral
- ◯ 4 = Engaging
- ◯ 5 = Extremely engaging

Why?

Q7. How likely are you to listen to the **full episode** after hearing this?

- ◯ 1 = Not likely at all
- ◯ 2 = Slightly likely
- ◯ 3 = Neutral
- ◯ 4 = Likely
- ◯ 5 = Very likely

Why?

Q8. Does the podcast sound like it was created by **humans** rather than **AI**?

- ◯ 1 = Definitely AI
- ◯ 2 = More like AI
- ◯ 3 = Neutral -- Could be either human or AI
- ◯ 4 = More like humans
- ◯ 5 = Definitely humans

Why?

Q9. (Optional) Any additional comments on this podcast audio?

Figure 13: Questionnaire-based MOS test - Final version (Question 6-9).

Table 10: Questionnaire-based MOS test - (Q.) represents the average score from the direct scoring answers, and (J.) represents the score derived from the justifications.

Metrics \ Systems	MOSS-TTSD		NotebookLM		PodAgent		Real-Pod	
	Q.	**J.**	**Q.**	**J.**	**Q.**	**J.**	**Q.**	**J.**
Information Delivery	4.0	3.0	4.2	4.0	1.6	1.0	4.2	4.0
Music/Sound Effects	N/A	N/A	N/A	N/A	2.4	2.0	3.3	3.0
Engagement Level	2.2	3.0	3.1	3.0	1.1	1.0	3.6	4.0
Full Episode Likelihood	2.1	2.0	2.1	3.0	1.0	1.0	2.3	3.0
Human Likelihood	3.0	3.0	3.3	3.5	1.1	1.0	4.2	4.0
Audio Quality	3.5	3.0	4.2	4.0	3.0	2.0	3.9	4.0
Speaker Expression	3.3	3.0	4.0	3.0	1.5	1.0	3.4	4.0

A.6 System analysis report

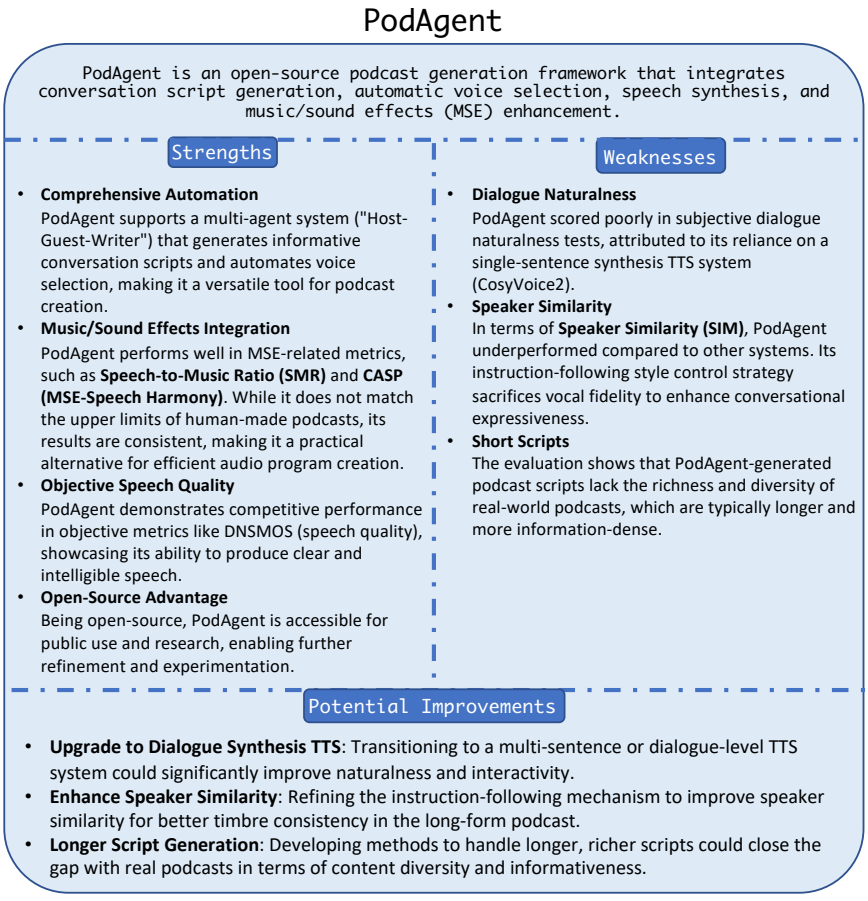


Figure 14: System analysis report based on PodEval - PodAgent.